SEVENTY-THIRD YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVI. NUMBER 20] NEW YORK, MAY 19, 1917 [10 CENTS A COPY $4.00 A YEAR

An Electric Camera for Deep Sea Photography

TESTS recently carried out aboard the U. S. S. "Vestal" indicate the complete success of a submarine camera for deep sea photography invented by H. Hartman, a civil engineer of New York. Controlled from above in every detail, there seems no particular limit to the depth at which this well-laid-out apparatus will work, and no job of under-sea photography for which it is not adequate.

As our illustration shows, the new camera consists of several separate cylinders, suspended in and connected by a rigid steel framework. At the bottom is the shock absorber, terminating in the big ball shown. When this ball strikes bottom the shock of grounding, which might otherwise throw some of the delicate mechanism out of kilter, is taken up. On the other hand, the ball is so connected that in case it gets fouled a pull of no more than three hundred pounds would suffice to make it slip off and free the rest of the apparatus.

Above the shock absorber is located the gyroscope which stabilizes the whole outfit against vibrations. The same compartment carries a 12-volt battery and a light motor to run the stabilizer.

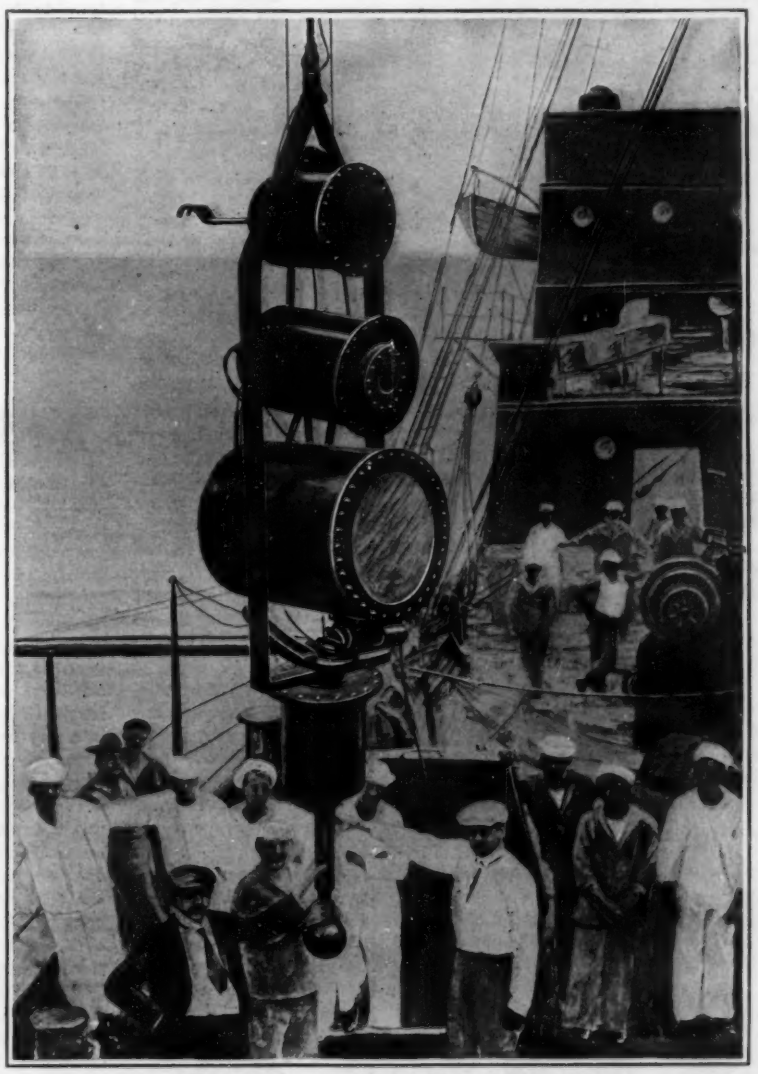
In order to take pictures in all directions, it is necessary to have a propeller rotating the entire apparatus upon its vertical axis. This propeller, with its motor, is situated in the uppermost cylinder. Much heavier and more powerful than the gyroscope motor, it draws its current from above, through a cable, rather than from a battery. This motor runs at 1,200 revolutions per minute, but the propeller is geared down to 400 revolutions per minute by means of worm gears. This normal speed, however, can be reduced as desired from the control switch-board on the ship. Propeller, shaft and bearings, of course, are of manganese steel to withstand the chemical action of the salt water.

The camera tank is the one below the propeller cylinder. It is closed in front with a steel cover having an opening in which the lens is fitted with the nicest care; for this camera is distinguished from others by the necessity that it be waterproof. The camera tank contains also the distribution board from which the wiring radiates, the focusing apparatus, the mechanism for tilting and swinging the cylinder and for operating the shutter, a microphone, etc.

The focussing arrangements are especially noteworthy; by a touch of a switch on the vessel above the focus can be altered at will or made to pass continually through any desired series of phases. In this way pictures of the same object or objects may be repeatedly taken; and while some will doubtless be out of focus, others will be sharp and clear. The shutter may be made to work continuously, intermittently, or only at the throwing of a special switch, so that either the moving or the stationary picture effect may be obtained; and this, in conjunction with the complete control of the rotation through the propeller, makes it possible to achieve any desired series of camera evolutions. The camera can be swung either in conjunction with the light projector or independently of it.

Considerable secrecy is maintained about the internal workings of the source of light. So far as is made known, the light projector consists of a strong steel cylinder, filled with nitrogen gas under varying pressure and having highly concentrated filaments. The heavy glass lens is protected from the heat by an inner circle of transparent mica arranged at some distance from the glass lens and having small openings to allow slow circulation of the heated gas. The pressure of the gas is varied automatically by a valve mechanism according to the pressure of the water in which the cylinder is submerged, the reserve gas being housed under very high pressure in a separate compartment. The filament is heated by the current to the absolute limit, with considerable generation of heat; but the surrounding water plays the part of a water-cooling mechanism and keeps the temperature down to the proper point.

Current for this light, of course, comes through the cable. In addition to this live wire, there is a flexible steel wire rope to carry the weight of the *ensemble*. This is not a great load, since the whole outfit weighs 1,500 pounds on land and but 100 pounds submerged. All parts are tested for a pressure of 500 pounds per square inch, which corresponds to a depth of some 1,000 feet of water. A current of approximately 100 amperes and 120 to 140 volts is required to operate the light projector and the various small motors. When operating in considerable depths, this voltage has to be increased to perhaps 200 to make good the loss in passing through the long cable.



Submarine camera aboard U. S. S. "Vestal"

It is hardly necessary to dilate upon the practical value of this device. Leaving out of consideration the scientific data which it may be expected to bring up from the ocean depths, it will surely be of great value in wrecking operations. A sunken submarine, for instance, may be located and its exact position and condition placed before experts on a small projection screen in hours where it would take divers days to secure complete information—if, indeed the depth were not too great for diving operations to be undertaken. And it requires little imagination to see it in constant use, after the war, in treasure hunting over the bottom of that portion of the sea which has been the scene of submarine warfare.

What is the Difference Between Coal Tar and Asphalt?

THERE is a tendency on the part of the general public to confuse coal tar and asphalt, and it is very evident that the two names are often taken to mean one and the same thing, which is quite contrary to fact.

Coal tar is a by-product from gas works and coke ovens, and is driven out of the coal as a gas; then, as the gas cools, the tar is condensed into a liquid form. It is of a gaseous origin and dries out too quickly. For this reason tars have been practically discarded in the search of makers of roofing material for the best substances to use.

Asphalt, on the other hand, is a natural product. Trinidad asphalt has been the best known, because most of us have read about it in our geographies and in books of travel. This deposit is on the Isle of Trinidad and is owned by the British Crown. It is about forty-five per cent fine earthy matter, owing to its working up from the interior of the earth, through a sand bed, and the fine sand or earthy matter is found throughout the material. A solution of salt in the water that flows around and through it also permits a salt to work into the asphalt, and this salt, being soluble in water, has a tendency to cause disintegration when water stands on it for a fair length of time. This earthy matter and salt are not sufficiently removed in the process of refining.

Other asphalts are less known to the general public because their names have not been in the geographies and have not been advertised. These asphalts are found generally throughout the world. Instead of being limited in supply, as has been thought at times, tremendous quantities have been located and it has also been found that the best product comes of the proper selection of these asphalts and a proper blending of them, having a full knowledge of the work to be accomplished by the finished product.

As previously stated, asphalt is not an artificial product; it is always a natural product. It is found in hard, soft and liquid forms in the earth. The only difference is that the natural distillation in the earth has been carried on further as the material is found in the harder conditions. The very hardest grades are those that have been dried out from the internal heat of the earth in ages gone by. When this distillation is not completed in the earth it can be done in stills by man in just the same way, and the residue is asphalt—a natural product. No artificial product has been created by this process—only the lighter materials have been driven off. It is sometimes urged that Nature does this work better than man. This is untrue. The work of Nature is the work of chance. The heat it employs is not finely regulated to fit the work in hand. Too high a heat is objectionable in either case, and Nature being a careless refiner may have used extreme heats. The best product is obtained where proper knowledge and careful work are used in securing the result, and man with his thermometer and with care based on intelligent research, does this better than Nature and gets a more uniform product.

All asphalts, hardened by natural drying out in the earth, require blending and treatment before they are ready for use.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, May 19, 1917

Charles Allen Munn, President. Frederick C. Beach, Secretary. Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Blockading the Blockaders

THE astonishing success of the German U-boats as shown by the sudden and alarming jump in the total number of ships sunk is due to several, causes: First, the construction of larger submarines and a great speeding up of the rate at which they are being set afloat; second, the transference of the field of operations from the shoaler waters of the North Sea and the Channel to the deep waters of the Atlantic; third, the construction of pairs of submarine mother-ships of over 2,000 tons displacement, to act with groups of fighting submarines on certain specified stations, one mother-ship serving as a receiving ship for the resting up of the crews, and the other as a supply ship for furnishing oil, torpedoes and shells for the fighting craft. Fourthly, the thorough organization of these deep-sea operations along clearly-defined strategical and tactical lines; so that all the avenues of approach to Europe shall be covered and a fairly continuous and unbroken line of blockade be established by independent, self-sustaining groups, or squadrons.

So vast is the present field of activity, and so widely scattered are the units of Germany's submarine fleet, that the problem of locating the enemy is far more difficult of solution than it was a year ago, when the Allies believed that they had the matter pretty well in hand. In the comparatively shoal inland seas and channels, the means adopted for detecting and intercepting the submarines were fairly successful; but under the new conditions, the submarine fleet is so large and its field of operations so extended that the earlier methods of defense and attack, judging from the enormous number of ships which are now being sent to the bottom, seem to have suffered a partial, if not a complete, breakdown.

The crisis is one which calls for heroic measures, measures which, in the earlier period of successful anti-submarine warfare, were considered, no doubt, but rejected as not being at that time necessary. Today, when the submarine raid has been developed to a point at which it promises to wreck the Allied hopes for a decision on land at the very time when they seem to be about to succeed, something has to be done on a scale commensurate with the great peril.

Therefore, we believe that the time has come for Great Britain to render the whole of the inland waters, extending from the Shetland Islands and Norway to the Straits of Dover, a closed sea, by building and maintaining a continuous line of netting from the northernmost points of the Shetland Islands to the nearest point on the western coast of Norway, and by similarly closing the open passages between the islands which form the Orkney and Shetland Island group.

A vast undertaking, it is true, but not nearly so vast as the peril to the Allied cause against which it would provide a certain protection. By thus blockading the blockaders within the North Sea, the trans-Atlantic routes would be opened up once more for the uninterrupted flow of the food, munitions and supplies which are necessary for that decision on land which the Allies now have within their grasp. The cost of this huge protective work would not be less than $15,000,000 to $20,000,000. A big sum; yet Great Britain is spending twice that sum every day of the war.

But the Germans have provided their submarines with a net-cutter—a revolving knife carried on the end of a long extension tube and operated from within the submarine. Well, there is an answer to that. Let this great net, 150 feet deep, be built of half-inch steel wire with a 10-foot mesh, and a ring at each intersection into which would be snapped a contact bomb, large enough to cut a hole in the submarine, or at least start a leak along the seams of her plating. Should the knife cut a strand of the wire, the submarine in forcing her way through would carry the flexible net with her, and as it swung in against her sides, one or more of the bombs would be pretty certain of contact.

Throughout the whole 250 miles of netting required there would be maintained a dense patrol of destroyers, torpedo boats and sea-going chasers, and at every 30 miles might be anchored a mother-ship, surrounded with a triple line of netting. These ships would form the permanent base for the patrol boats and for a large fleet of aeroplanes.

The depth of water, in feet, on the line proposed, running east, is as follows: 360 feet, 480, 510, 462, 372, 600, 942, 1,020 feet. These are formidable depths, but they could be overcome by a sufficiency of mushroom anchors and steel-wire cable. Such a blockade could be broken only if the battleship fleet of Germany came out in force, which is the very thing that the British Fleet is hoping that it will do.

The Proposed Tax on Publications

THE question of the proposed "War Tax" on weekly and monthly publications suggests the question:

Is the proposed tax a just tax, and is it a wise piece of legislation?

The necessity for raising immense sums to meet war expenses does not justify the enactment of laws which will strangle business enterprise and bring about business calamity.

The zone system of postal rates is *unscientific* because it establishes different subscription rates for subscribers living in different parts of the country. There is no reason why the subscriber in St. Paul should be compelled to pay a higher subscription price, perhaps, than the subscriber in Minneapolis. No intelligent way has been indicated by which a publisher can establish the zones from the door of his publishing office. Different zones would have to be established for each town or city. Even if such zones are arranged by meridian lines, dividing the county into sections similar to the time zones, the subscription department head has a hopeless task in dividing his mail according to such zones and paying the varying rates according to such geographical division.

The present proposed plan, however, of having a rate of 2 cents a pound for mail distribution covering an area 50 miles from the place of publication, or 3 cents a pound for an area of 300 miles from the place of publication, or 4 cents a pound for an area of 1,000 miles from the place of publication, up to 6 cents a pound for more than 1,800 miles from the place of publication, would establish a method of postal rates which would be so intricate, so difficult to carry out, so confusing and so impracticable that the publisher would find it almost impossible to carry out these requirements, and would be compelled to employ a staff of clerks to carry out the detail of such requirements just at a time when it is becoming every day more difficult to obtain clerks even at ever advancing salaries. The confusion which would arise in the Post Office Department and the increase of staff which would be necessary to carry out the work, would add enormously to the expense of our postal department just at the time when it, also, will be suffering from a like shortage of labor.

The system is *unbusiness-like* because it is unscientific, because it is vexatious to the subscriber, because it is unnecessary and burdensome to the publisher, and, lastly, because a law which tends to embarrass and cripple business enterprises is as unwise as it is unjust, since it tends to destroy all over the country, legitimate enterprises which tend to increase the general prosperity of the country.

It is *unjust* because it is directed against one particular class of business only. The houses that will be affected by the proposed law are the publishers of weekly and monthly publications only. It is not apparent why they should have been singled out for such a special form of taxation. The proposed law does not affect in any way the cost of circulating daily papers while the county publications are delivered within the county of origin free of all postal charge.

It is hardly the object and aim of legislation to throttle and destroy business enterprise. In determining the wisdom of imposing new tax burdens on an industry, the first point that must be ascertained is whether the victim can survive the operation. The conditions in the publishing business since the beginning of the war have gone from bad to worse. Besides the increased cost of all materials, and especially ink, certain kinds of which cannot be obtained at any price, the greatest blow to the publisher has been the increased cost of paper. At the lowest estimate, a publisher of a weekly or monthly publication who spent, for example, $100,000 for paper in 1915 is compelled in 1917 to pay from $160,000 to $175,000 for the same grade and quantity. This is a stern fact from which the publisher cannot escape. His business has been jeopardized by circumstances quite beyond his control, but these conditions have been considered of sufficient importance to justify a Congressional investigation into the cause of this rise of prices, and indictments have been found in the case of certain manufacturers. This investigation was confined, unfortunately, to news print paper only. It has not resulted in any relief for the publisher of periodicals who is facing a serious business situation. This grave condition, however, is not the sum total of his misfortunes, as he is now confronted with an increase of postal rates which will amount to from 300 per cent to 400 per cent. In short, if the postage bill of the same publisher who spent $100,000 for paper in 1915 is taken as a standard, it would amount, approximately to $30,000 a year. Under the new rate his postal bill will climb to the ruinous figure of $90,000 per year or over. Considering the small margin of profit which the general publisher enjoyed prior to the war (except, perhaps, a very few publications of gigantic circulation) it may readily be seen that the enforcement of this proposed rate would be the last straw.

Publishers are prepared to do their full share in supporting the war burdens; they are prepared to meet any legitimate and scientific method of taxing profits, but it is neither legitimate, scientific, wise nor just ruthlessly to impose, under the name of a *War Tax*, an assessment which will turn the small margin of profit the publisher may at present enjoy, into a deficit. The business of the publisher is a legitimate business, and it deserves in most cases to be encouraged rather than destroyed. It cannot be to the benefit of the commonwealth to have its business enterprises crippled or destroyed, whether this is done under the guise of a war tax or not.

If this whole matter is considered as a war measure only, irrespective of the moral rights of the victims of the tax, the question naturally arises: Will this enormous increase in postal rates result in a great increase of revenue, or will the crippling of the publishing business as a business be so extensive and far reaching, and result in so many failures, that there would be in the end little, if any, increase of revenue? Should this follow, not only would the great moral wrong have been committed wilfully by the Government, but even the only excuse for this procedure, that of expediency, would be found to be a failure. The argument that this is a war tax, and, therefore, justifiable is unfortunately not supported by the facts of the case. It has been known for many months that this plan is a favorite device of the Postmaster General. A bill was introduced in the last Congress advocating this very method of taxation, which is now brought forward as a war plan, and it failed of passage by Congress. If this was an immoral and unjustifiable measure at that time it is equally an immoral and unjustifiable measure now.

Daylight Saving in France

IT will be remembered that the daylight saving method was adopted in France for the summer of 1916, and that accordingly from June to October the clocks were set forward one hour. This year the project has come up again; and while last year the novelty of the scheme was doubtless responsible for much of the opposition, this time approbation appears to be almost unanimous.

As an example, it is stated that on June 15th of last year, at which date the old time still prevailed, one of the large concerns generating current for sale in Paris, furnished some 31,000 kilowatts per day, and that within a day or two of the change this figure fell to 29,000. Although not of great magnitude, this saving is well worth effecting; and it is especially noted that it occurred at the time of the year when the days are longest anyhow, and when accordingly economy from setting the clock ahead would be a minimum. In fact, when the normal daytime distribution of the hours was restored in October the above mentioned plant was running on a nightly peak load of 35,000 kilowatts, which within a few days of the change jumped to 53,000 kilowatts. On this basis the economy effected by the plan is one of 51 per cent.

Another instance is found in Toulouse, where during July the additional current available for power use because of the lessened demand for lighting purposes was estimated at 1,000 kilowatts per day. Again we remark that at this season, when there is very little lighting of stores and factories, such an economy is surprising. Reports from Nimes, Dijon and Blois place the economy of the daylight saving plan at 25 per cent for hotels, 30 per cent for clubs and 40 per cent for wholesale places, this figure representing the saving in current used for lighting.

Chambers of Commerce and workmen's organizations throughout France are enthusiastically in favor of daylight saving this year. According to the syndicate in control of the gas industries, the saving here amounts to one ton of coal per month per thousand inhabitants, which is a very considerable item in the larger cities at a time when coal is as high as at present.

With these concrete examples of the success of the daylight movement in France before us, and knowing also that daylight saving has been adopted in all the principal countries of Europe, this country may well afford to try the experiment. We might add that the amateur who is trying to cultivate a home garden, will appreciate additional daylight after business hours, rather than before, when the dew makes work in the garden unpleasant and sometimes harmful to the plants.

Aeronautical

Canada's Aerial Armada.—If newspapers have it right, it is understood that Canada has started to spend the $80,000,000 recently set aside for the aeronautical development and aerial protection of the Dominion, and soon will possess a giant air fleet. The Canadian plans call for 280 aviators always in active service, and at the usual rate of three machines to each man there will have to be 840 machines ready at all times. Aeroplane factories and training camps are being established.

Tremendous Wastage in Air Services.—Time and again in these columns attention has been directed to the tremendous cost of the war in aircraft, but at no time since last September has the monthly total of machines destroyed approached that of April. A compilation from British, French and German official communiques shows that 717 aeroplanes were shot down on the Western front during the month just brought to a close. The Germans are said to have lost 369, the French and Belgians 201, and the British 147. Last September, while the Somme battle was at its height, the total was 322.

What American Machines are doing Abroad.—In a recent interview Major L. W. B. Rees of the British Royal Flying Corps, cast interesting light on the fate of the American aeroplanes purchased by the Allies. He stated that many American machines are in use in England for training purposes, but none on the fighting line. The American engine, in his opinion, has developed to a noteworthy extent, but the rest of the American machine has not been submitted to all the tests which the Allied machines have had to meet, hence is not so fast nor so great a weight carrier. This statement is precisely in accordance with that of Lieut. Faulkner, whose articles have been appearing in this journal.

Scenic Effects to Protect Vessels Against Airmen.—According to a news despatch from Copenhagen, it is understood that Hamburg expects hostile aeroplane visits the coming summer, and the commanding general there has issued instructions for the conduct of the population in case of aerial attack. Although other German cities have of late been the victims of raids by Allied airmen, in the instance of Hamburg the German authorities have expressed no great anxiety. However, since the beginning of the war the steamship "Imperator" has been covered with a roof painted to represent fields of water, as a protection against aerial raids.

The Past Year's Destruction of Aeroplanes is reviewed by the *Guerre Aerienne*, which states that nearly 900 enemy aeroplanes were brought down, the French accounting for 450 and the British 250. Of 81 observation balloons brought down, 41 fell to the French and 27 to the British. Although the summary only goes from January 1st to December 20th, it is stated that when the figures for the last ten days of the year are added it will be found that in one year the Allies have carried out at least 750 bombardments, of which France was responsible for 250 and Great Britain for 180, to which must be added 174 which took place in Macedonia. The monthly reports show that the rate of progress has been constant from January to the end of September, since which time the atmospheric conditions have compelled aviators to moderate their activity.

A Most Deplorable Accident recently occurred at the Mineola flying field, Long Island, in which Ransom Merritt of Lockport, N. Y., and Anthony D. Spileno, of Roosevelt, L. I., were killed when a machine they were flying crashed to earth from about 5,000 feet altitude. It appears that both the victims were students at the Army school, and were, in accordance with the present method for training aviators, undergoing preliminary schooling as mechanicians. They had been detailed to tune up the engine of a L. W. F. biplane, and having completed their task they were wheeling the plane to one of the gasoline tanks when Merritt evidently conceived the idea of taking the aeroplane up, notwithstanding the fact that he was totally inexperieneed. Merritt was seen climbing into the machine, followed by Spileno who first gave the propeller the initial twirl. At a dizzy grade the runaway biplane rapidly ascended over the aviation field until it reached about 5,000 feet, while an officer on the ground, realizing that an accident was imminent, summoned the post ambulance and a physician. The big plane pitched about for a half hour or so, when it started down at a terrific speed. During what seemed to be an attempt on the part of the pilot to right the machine, the left wing was seen to break away, and the machine, now tilted to a perpendicular angle, shot to the earth about 500 feet from one of the hangars. Officers and others who rushed to the wreckage of the machine found both men dead. The machine, together with its 135-horse-power motor, was a total wreck. No definite reason has been forthcoming for this strange accident, although the suicide motive has been suggested by persons who knew Merritt. Temporary insanity, too, has been suggested as a possible explanation of the fatal act of the two men. Still, the accident remains wrapped up in deepest mystery.

Science

The American Museum of Natural History.—During the year 1916 the visitors at this, the most important scientific museum in New York City, numbered 847,675. The attendance at the lectures given at the museum was 96,353. Lantern slides were sent out for use in schools to the number of 38,912, and 1,118,000 school children were reached by nature study collections.

The Mountain Laboratory of the University of Colorado will have its ninth annual session of six weeks from June 25th to August 4, 1917. The laboratory is situated at Tolland, Colorado, in the Rocky Mountains, 8,889 feet above sea-level. The courses given cover the subjects of field zoölogy, field botany, ecology, and the relations of fauna and flora to climate. No elementary instruction is given.

Blindness in the United States.—According to statistics collected by the U. S. Census Bureau, in connection with the census of 1910, the blind population of this country was 57,272. Data concerning the cause of blindness and the age at which it began have been obtained in connection with about half of these persons. Of the number, 6.6 per cent were born blind, and 5 per cent lost their sight when less than a year old. More than two-thirds became blind when more than twenty years old.

A Graphic Summary of World Agriculture.—A collection of charts, with introductory text, bearing the foregoing title is one of the notable features of the 1916 Yearbook of the U. S. Department of Agriculture, and has been reissued as a separate pamphlet, which constitutes a handy miniature agricultural atlas of the world. A series of 19 maps on the Mercator projection shows, by means of dots, the geographical distribution and relative density of production of the principal crops and farm animals of the world, while a series of graphs in connection with each chart shows the relative importance of the United States in the world's markets with respect to each product.

Geographic Names in Panama.—According to a recent decree of the Government of Panama, all places in that country are hereafter to bear Indian or Spanish names. There are now many places in Panama bearing English and other foreign names. Where these have have supplanted old Indian or Spanish names, the latter are to be restored, while if no such old names exist, new Indian or Spanish names will be given. Nine months after the revised nomenclature is announced the post-office will refuse to deliver mail addressed to places by their foreign names. This drastic provision regarding the non-delivery of mail seems decidely unreasonable, not to say puerile, and it is to be hoped that the good sense of the Panamanian authorities will lead them to withdraw it.

Model Houses for the Philippines.—The Philippine Health Service has turned its attention to improving the housing of the poor in the Philippines, where highly combustible and unsanitary nipa structures are now the rule. The Service has constructed a number of model houses from a new fireproof material, consisting of equal parts of cement, sand and ipa, or husks of rice. This material is molded into shingles for the roof, and slabs for the walls, the slabs being two by six feet in surface area and half an inch thick, and weighing about six pounds per square foot. The model houses contain five rooms, with a porch, and cost $250 each, which is about the same as for those of nipa construction, making allowance for the frequent repairs which the latter require. It is said that the new-style houses will last twenty-five years, while nipa houses generally last only ten years. The new houses are far more sanitary than nipa houses, which harbor rats and insects in abundance.

Agricultural Use of Lime.—From a summary of recent experiments on the use of lime, conducted at agricultural experiment stations, the following facts may be selected as noteworthy: At the Pennsylvania station during a long series of years it was found that the use of burnt lime gave no crop increase, while pulverized limestone showed a crop-producing value of $1.20 per ton of limestone used. No evidence was found that caustic lime causes the loss of soil nitrogen by the destruction of organic matter to any serious extent. The Rhode Island station has, during the past twenty-two years, conducted experiments on the effects of lime on 280 different varieties of flowers, trees, small fruits, grasses, clovers and miscellaneous crops. Lime is used to neutralize excess acid in the soil, as well as to increase the available calcium plant food. The Rhode Island experiments show that the difference in the residual effect on soil acidity of sulfate of ammonia and nitrate of soda is quite marked. Among the plants found most sensitive to soil acidity are asparagus, barley, beets, celery, leek, lettuce, onions, clover, spinach, and tobacco. At the Iowa station the lime requirements of the soil were found to amount to from 3½ to 5½ tons per acre. After the acidity of the soil has been neutralized, the addition of a ton or two of limestone per acre every five years appears to be sufficient.

Industrial Efficiency

Paper from Spinach.—A French horticulturist, M. de Noyer, proposes the stems of spinach for making paper. These contain 46 per cent of cellulose against 6 per cent in the stems of wheat straw. M. de Noyer claims that in his experiemnts in making paper from spinach stems he has followed the methods of the Grenoble paper-making school and has produced a product equal to the best Japanese in its remarkable consistency. He intimates in an article quoted in the *Journal of Industrial and Engineering Chemistry* that with the proper culture of spinach for this purpose, remarkable economies in the manufacture of paper may be achieved.

Safety First Films for Railway Men.—A motion picture car is to be put in service by the Canadian government railways, to demonstrate the principles of "safety first" in their application to modern railroading. Built under the authority of the Ministers of Railways, the car is now well on the way to completion at the Moncton shops. The exhibition will consist of pictures dealing with the danger of taking unnecessary chances in the performance of railway duties, and will be of value to employees over the entire system. It is expected that a week will be spent at each of the divisional and terminal points, and as the seating capacity of the car is limited to 48 persons, it may be necessary to spend more time at some of the larger points.

English Women as Engine Builders.—The British Ministry of Munitions is extending its plans for the employment of women in engineering work. Classes for training in setting-up and skilled operating on various types of machines are being held in London, and the Ministry appeals to women of good education and physique, between 20 and 35 years of age, to undertake the training. The course will last from eight to nine weeks. Maintenance grants will be paid during this period, and those who become fully proficient for service in aero-engine or other munition work may expect a minimum wage of ten dollars per week. Candidates must be prepared to accept employment in any factory to which they may be sent on the completion of their training, and to work during the usual factory hours.

Chemical Business with France.—Dr. F. J. LeMaistre of the American Industrial Commission to France, has written of the chemical industries of that country in the last number of the industrial journal of the American Chemical Society. As in other countries, French chemical industry lagged behind that of Germany previous to the war. Manufacturers now realize that after the war they must specialize, coöperate and abandon inefficient plants and those unfavorably located. Formerly they bought a large part of their chemicals from Germany and they desire in the future to purchase many of them from the United States. But they candidly admit that in many respects the German manufacturers were better informed as to what they wanted than they were themselves. American manufacturers lack the underground help which the Germans enjoyed. Another difficulty, which the Frenchmen cannot understand, is why so progressive a country as this is so slow in the adoption of the metric system of weights and measures. They cannot understand pounds and ounces and gallons and feet and inches.

Postures at Work.—Numerous departures from the normal posture appear in every degree from a very slight and almost imperceptible curvature to a marked deformity and produce corresponding deviations from normal health, in many shop and office workers. It is therefore of great importance that every effort be made to prevent the establishment of such conditions, or if once established to correct them. With this in view every employer should endeavor to obtain the best possible working conditions for his employees—suitable seats, proper desks or work benches, sufficient light falling upon the work at the correct angle and frequent change of position in work requiring close application. This alone is, however, not sufficient, for unless the workman can be made to realize the necessity for correct posture he will be benefited very little. In most establishments little more can be done than simply to call attention of all workers to the dangers consequent upon the assumption of incorrect postures, adding to the conditions noted above, the ever-increasing susceptibility of the individual to tuberculosis as the supply of fresh air reaching the lungs is diminished. Definite instruction, continues the *Monthly Bulletin* of the Pennsylvania Department of Labor and Industry, to bend the body at the waist instead of at the shoulders in work requiring close application, will, if followed out, not only eliminate the hump on the back but will surprisingly diminish fatigue. Regardless of what method is pursued in dealing with this important question, two facts should always be borne in mind: One is that a deformity prevented is very much more to be desired than one corrected; and the other is that the sooner a deformity is detected, the easier it is to be corrected and the less serious are the results wrought by it on the individual.

American trucks in the service of our Allies in Macedonia. Hauling out a truck that has been ditched

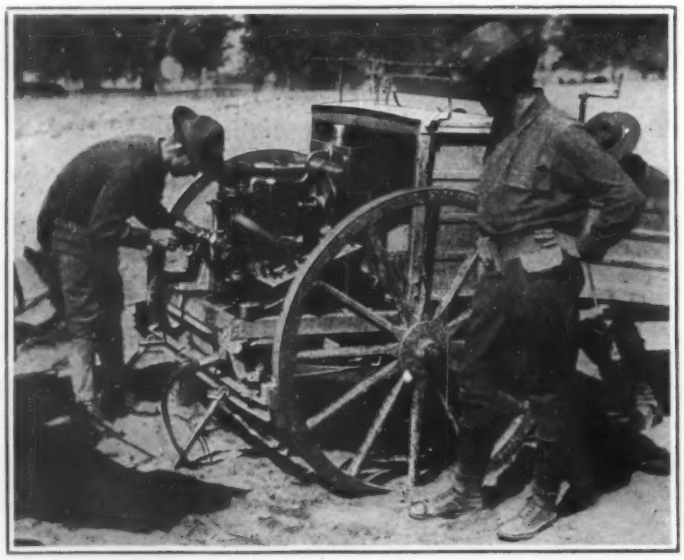
Motor Traction in Modern War

Making Our Army the Most Completely Motorized of Any in the World

By Victor W. Page, M.S.A.E.

MODERN warfare is essentially a conflict of men aided by machines, and not of men alone as many previous wars have been. The unobtrusive, peaceful mechanisms of the shop and farm are now fully as important as the more spectacular, death-dealing machines of the forces afield or afloat. No machine has proved to be of greater value than the automobile in the present war as a medium of transportation in both passenger and freight-carrying forms. The gas tractor also has demonstrated its capacity as a war machine of as great value in destructive operations as it has been in constructive work. The motorcycle, aeroplane, dirigible balloon, and swift submarine "swatter" are radically different forms of motor-propelled vehicles, yet all owe their efficiency and are made practical by the successful application of the same type of power plant that has made the automobile a commercial possibility.

If there was ever any doubt regarding the real value of motor transport in warfare, whether on land, sea, or in the air, it was entirely dispelled before the war now raging was more than a day old. The rapid movement of the Teutonic hosts through Belgium and northern France would never have been possible without motor transports. The marching soldier of the past is practically obsolete in this war. About all the marching there is to do is from the armory or mobilization point to the railroad station and from the railhead to the army base not far distant; indeed, footwork is wellnigh extinct.

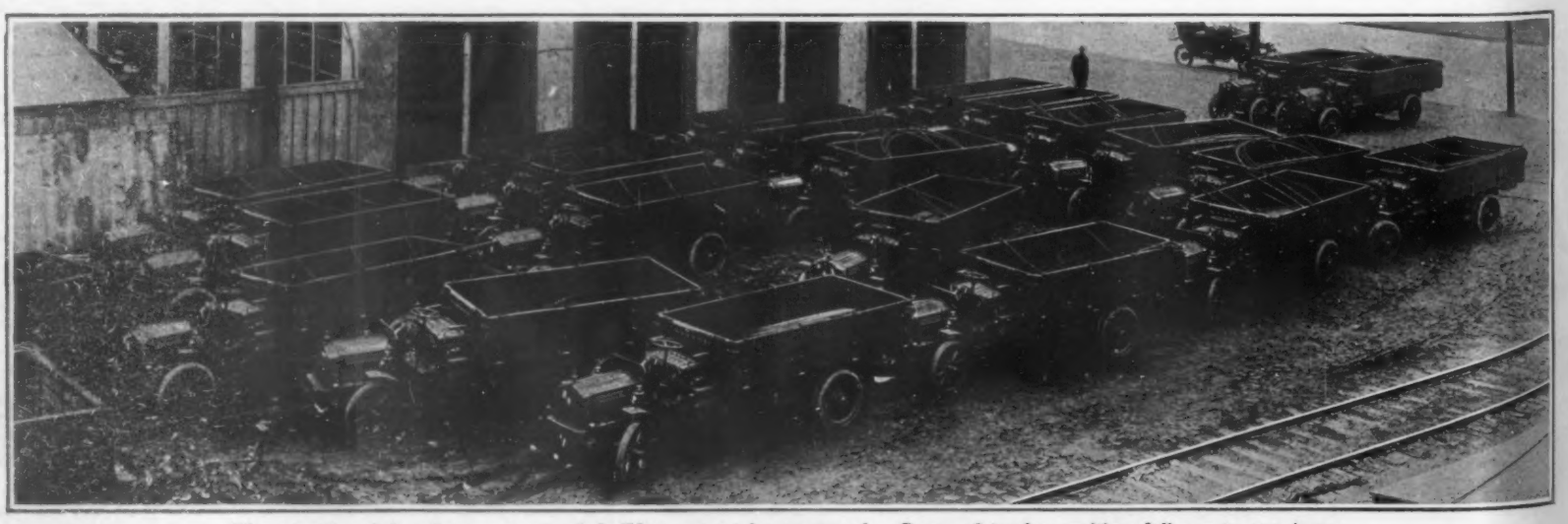


Copyright, Underwood & Underwood

Power plant for radio-service mounted on a trailer

While motor vehicles contributed to the rapid advance of the invaders in France, they proved of even greater value to the defenders in checking the movement that seemed almost irresistible. It is stated authoritatively that the defeat of General Von Kluck's army, at the critical time when it was almost at the gates of the French capital, was accomplished largely by a surprise attack which crumpled up a wing of his army and forced a retreat. This attack was made by divisions of the reserve army that had been detailed to defend Paris and who were rushed to the Marne region by taxicabs, pleasure automobiles and busses.

The siege of Verdun and its heroic defense will go down in history as a victory for the French arms made possible only by the motor transport. With the railroads leading to Verdun destroyed and always under heavy gun-fire which prevented their reconstruction, theories of war based on past experience led the Germans to believe that but a brief investment would be required and that the defending forces would be forced to retreat through failure of ammunition and supplies. Thousands of motor trucks, a large proportion of which were of American manufacture, were rushed to the threatened sector. An unfailing stream of supplies, ammunition and reënforcements was maintained despite the severest possible shell fire.



The capacity of American motor truck builders cannot be surpassed: Group of trucks awaiting delivery to our Army

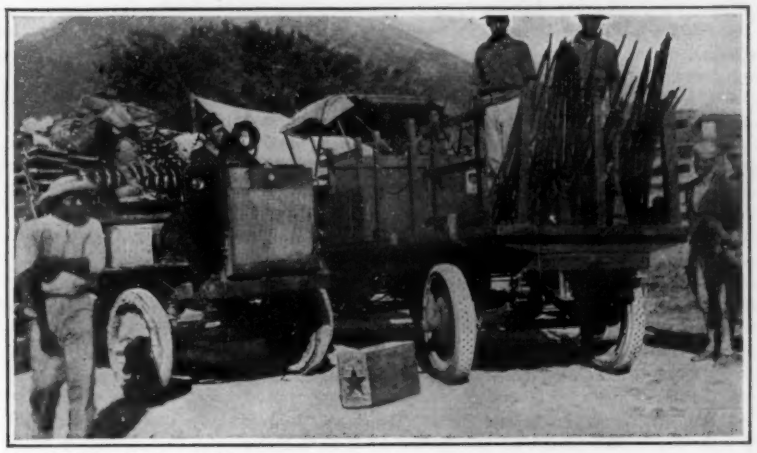
Copyright, Underwood & Underwood

American motor convoy on a dusty trail through the boundless Mexican desert

The experiences of our own Army in Mexico and in the operations on the border has demonstrated to our Army authorities that motor transport is essential to the proper conduct of modern warfare. The United States is especially fortunate in having more motor vehicles in use in its territory than has all the remainder of the world combined. Supposedly reliable statistics show that there are over 3,500,000 motor cars of all types in use in our country. Fifteen States have more than 100,000 motor vehicles registered in each one, and a count just completed in New York shows more than 300,000 trucks and passengers car in use there. At least four States, California, Illinois, Pennsylvania and Ohio can show over 200,000 motor vehicles registered in each. These stupendous figures show that in case of need our Army transportation requirements could be more than met by a selection of a small part of the vehicles already in service. Furthermore, this could be done without crippling industry, as was unavoidable in France, England and Germany when the commercial vehicles were commandeered for war purposes.

Even though the production ratio of our truck builders may be affected to some extent by new war conditions, which might result in the use of some of their factories for the production of other needed articles besides motor cars, those left in the industry will be able to supply, with new product, all the motor vehicles that our greatly enlarged Army will need. This demand will be met just as fast, if not faster, than the Army can be organized to use them. The state of our automobile industry and the magnitude of its productive capacity is such that unless some unforeseen emergency should present itself, our Army will be supplied with new trucks built especially for it, and our industrial organizations will not be deprived of their transports. There is no other country or combination of countries in the world that could meet a demand for motor vehicles such as we are about to meet so successfully.

While most of the trucks are now used in the Quartermaster's Department of our Army, plans in the making will result in their use by nearly all branches of the staff and line. Armored cars will be used for reconnaissance purposes; heavy "tanks" and powerful land dreadnoughts must be built for offensive purposes. Portable workshops and power plants, wrecking outfits, field kitchens, searchlights, ambulances, signal corps supply wagons, wireless outfits, engineering corps equipment, tank wagons, trench digging and road building machinery, artillery caissons and limbers, etc., *ad finitum*, all must and will be motorized; and the United States has nearly all the necessary driving and maintenance personnel in the form of a motorwise citizenry, already available to be drafted into the service.



Copyright, Underwood & Underwood

Motor trucks used by our marines in Haiti

Owing to our unequalled facilities and the great strength of our automotive industry, the new American Army should be the most completely motorized of any in the world, and this will be an asset that cannot be passed by lightly. The vast number of motor trucks that will be required can be appreciated by consideration of the fact that it will take 8,000 trucks of one and one-half tons capacity, 6,000 of two tons capacity or 4,000 of three tons capacity, to maintain the proper supply of food and munitions for a force of 500,000 men such as it is proposed to raise as a first unit of our large land fighting force to supplement our augmented regular establishment and the erstwhile National Guard. A division of troops, approximately 22,000 men requires nearly 100 tons or 200,000 pounds of food daily. This in itself is a hauling task of some magnitude, not to consider the added transportation needed for other supplies and for furnishing ordnance and ammunition during a conflict. Add to the transport and combat needs, the large number of special vehicles such as ambulances, portable radio stations, aircraft squadron convoys. self-propelling machine shops, mobile searchlights, artillery carriers and other special vehicles required, and it will be evident that the automobile industry will be well occupied for some time to come in supplying new equipment and trucks to replace the inevitable wastage.

The last annual report of the Quartermaster General of the Army reviews, in great detail, the experiences of our motor transportation department. The first motor truck for carrying supplies in the United States Army was procured in June, 1907, and since that time the department has made considerable progress in developing motor trucks for transportation purposes. The development of this important branch of our service was held back by the same short-sighted national policy that has retarded the general development of the Army for many years past. This is no fault of the officials as the head of the Army, as appropriations for even vitally important Army departments have been very limited. At the start of the trouble at the Mexican border a call was received from the Southern Department for two motor truck companies, each consisting of 27 motor trucks of one and one-half tons capacity. By the end of the fiscal year, 1916, ten motor truck companies each containing 27 motor

(Continued on page 502)

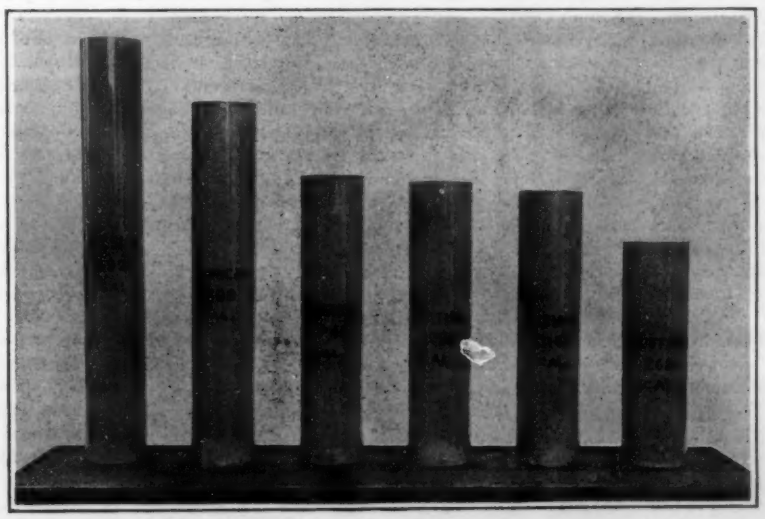


Photo from American Museum of Natural History

Comparative value of the food rations of different soldiers

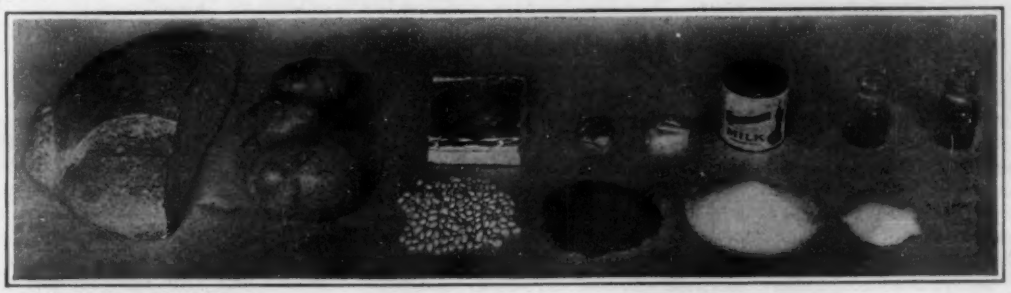


Photo from the Museum of Natural History

A day's ration of the United States soldier, which represents a food value of 4,199 calories

What a Soldier Eats

IN view of the current discussion of food matters, it is of interest to learn just what a soldier is supposed to eat in the course of a day's work. Those of us who do not care to model their own diet after this officially approved standard can at least amuse themselves by using it as a basis for calculating how long the visible supply of things to eat will last. We accordingly reproduce herewith a photograph of a collection of foodstuffs constituting a typical daily field ration of the United States soldier; the original may be seen in the main entrance hall of the American Museum of Natural History, in New York.

Most of the items are familiar enough, though two or three of them possess a certain flavor of mystery. It is not, however, so much the question of identity that is the burning one as it is the question of quantity. On the day represented by this ration Uncle Sam's

(Concluded on page 505)

Building the Emergency Fleet

Plans for the Construction of Wooden Ships at the Rate of Three Per Day

By C. H. Claudy

FROM the bewildering and contradictory stories published recently in newspapers regarding the building of the emergency fleet, two facts stand out in great prominence. The United States is about to start in the shipbuilding business, under the name of the United States Shipping Board Emergency Fleet Corporation, with a capital of $50,000,000, fully paid in, non-assessable and non-dividend paying, and—not a single keel has yet been laid down for a single one of the 1,000 ships Uncle Sam is supposed to be in such a hurry to build.

Many ship yards are preparing ways, but in no yard as yet is a single hammer falling, a single saw buzzing through lumber for a single ship of the emergency fleet.

To those who are familiar with the situation, this latter is not necessarily surprising, or indicative of unnecessary red tape and delay. "Make haste slowly" has been demonstrated to be a first-class way to build a canal which no one else could dig, and constructing a thousand bottoms is, if not a task, as big as cutting through forty-some miles of land and making the cut "stay put," at least some sizable task.

Plans for the vessels are now complete and if the present ones, by Theodore Ferris, naval architect of New York, and the specifications approved by the United States Shipping Board, are the final word, keels will be laid in the near future.

The shipbuilding program is by no means to be confined to the building of wooden ships, although they will undoubtedly make up the greater part of the emergency fleet. But the Shipping Board is doing all that can be done to stimulate the building of steel ships, and it is hoped that before many days have passed, keels of steel freighters will be laid down in many of the yards able to push such work rapidly to completion. Obviously, a ship yard capable of turning out wooden ships can be constructed with a much smaller outlay of capital and in much less time, than can those equipped for building with steel. Therefore, steel bottoms, at least in the immediate future, must come from yards already in existence, whereas wooden ships will be built not only in existing yards, but in many new ones.

The emergency fleet will be built, if not in every ship yard on the Atlantic, and Gulf, and Pacific Coasts, at least in a great many of them. Shipbuilders are given to understand that the thousand ships do not, by any means, represent the maximum number which may have to be built. A thousand is a convenient number to begin on, but the number wanted is indefinite—it is only known of that number that it must be "enough to beat the submarine."

Shipbuilders of the country are being interested in three ways, all potent.

First, patriotism. The number of offers of ways already in existence on which to lay keels, and the proffers of responsible business men to invest the amount necessary to provide additional ship yards, shows that the shipbuilding interests are more than ready to "do their bit."

Second, the price. It is estimated these ships will cost the government about $300,000 each. But the price paid the builders will be the cost of material, plus the overhead cost, plus ten per cent of all cost, as the profit. At first sight ten per cent may not seem a profit big enough to interest capital. But it should be noted that the ten per cent is upon the *cost*, and the cost is paid, not by the private capital invested, but by the United States. The actual capital necessary to be invested in creating new ship yards is comparatively small, and the Government will finance both the labor and material charges in monthly payments as the work is done. So the ten per cent profit is by no means unattractive.

The third lever is not in evidence as yet, save in the minds of newspaper scribes, and the back of the heads of every one concerned. The United States Government undoubtedly has the power and unquestionably will use it, if necessary, to construct its own ship yards and to commandeer every existing ship yard, if there should not be a sufficient response to patriotism and ten per cent on a loaned capital should not prove to be sufficient inducement.

One million two hundred thousand feet of lumber is the estimated amount which will be required for each ship. Naturally those localities where lumber is readily available will turn out ships both faster and more cheaply than those portions of the seaboard to which lumber must be shipped. But cordial coöperation by railways is promised for shipyards located some distance from forests. In this connection it is noted that not only will the Pacific Coast, adjacent to almost unlimited lumber, undoubtedly be a potent factor in the carrying out of the only practical submarine beating plan so far devised, but the Gulf Coast should come in for a large share. Not only has it a tremendous lumber supply near at hand, but the southern labor market is well stocked. Negro labor is perhaps not skilled in ship building, but these ships will be, as far as possible, standardized and simplified, and the specifications, at least so it is hoped by every practical shipbuilder, will eliminate much of those features of "regular" ships which require highly skilled labor to produce. It may perhaps, be stretching a point to denominate the probable final plans as promising a fleet of glorified scows, but the ships will certainly lack something of the grace, lines and speed of an ocean greyhound, if losing nothing in seaworthiness and sturdy carrying capacity in spite of its speed of building and simplification of construction.

It was first proposed to put Diesel oil engines in these bottoms as power plants, but it was speedily ascertained that this was not possible. The Diesel oil engine is not built in this country to any extent, and it is obvious that speed of hull building will go for nothing if power plants cannot be provided with equal rapidity. Hence, it seems hardly open to question that steam will be the motive power. A minimum of 1,500 horse-power will be needed, oil will be used as fuel, and it is stated on authority that both reciprocating and turbine engines will be used to drive both single and twin screws.

Investigations by the Shipping Board have demonstrated conclusively that delays in putting these ships in service will not come from engine builders, of whom there are enough to supply power plants faster than they could possibly be used.

After the first keel is laid, it is calculated that the vessel will be four months on the ways and six months between keel laying and commissioning. After the first six months, these ships should be ready at the rate of three a day, or approximately 1,000 completed by January 1st, 1918.

It is planned to give these hulls a speed of ten knots in ordinary passage, but to provide them with boilers sufficiently oversize to allow a forced draft to extend this speed to 12 knots. It is well recognized that, inasmuch as many enemy submarines have a surface speed of 17 knots, it is hopeless to try to make the emergency fleet with heels swift enough to be shown to the enemy. All that can be done is to give them the average speed of the average cargo vessels, and to provide them with ample means of defense in the form of guns. This part of the plan is being worked out in the Navy Department, which will provide the ordnance and ammunition, by which these cargo carriers, designed to beat the submarine by carrying food and material across the water faster than the submarines can sink them, will also become, perhaps, offensive war vessels as far as submarines are concerned.

Mr. William Denman, Chairman of the United States Shipping Board, and President of the Emergency Fleet Corporation, has devoted a great deal of time and much expense to working out the tremendous number of details in connection with so great an undertaking. A corporation lawyer with much experience in shipping matters, Mr. Denman has thrown himself heart and soul into the work and is vitally interested, from patriotic motives alone, in seeing it a success. As an instance of his far-sighted policy, consider his plan in relation to the arming of the emergency fleet. He believes that these guns, properly manned, may be an offensive as well as a defensive asset to the United States. But he also believes that the ships offer a wonderful opportunity for the merchant marine of the future. To this end he proposes to raise and train efficient gun crews from young men of the Middle West, as far as he can get such to serve, believing that there is not likely to be any better opportunity of interesting the great inland section of this our country in the merchant marine and showing it the needs of a merchant fleet not only for the present war emergency, but for future times when the warfare on the sea shall be only a commercial one.

For these boats, designed as an emergency measure, would be entirely serviceable for cargo work for years to come. Their lives, perhaps, would be less than those of stauncher wooden vessels, made by experienced shipbuilders of carefully selected and well seasoned timber, but they will undoubtedly outlast any war the world is likely to have, and be a peace factor for many years to come.

To be of a probable five thousand tons displacement, these cargo ships will carry 3,200 gross tons of cargo, and be designed solely as such. It is possible that some might be turned into troop transports if the need arose, even if very uncomfortable ones, but their main function will be the hauling of foodstuffs and supplies, and they are designed with that end only in view.

One of the really difficult problems which President Denman and General Goethals, Director, have to face, is that of officers and crews. A minimum of 35 men will be required to take one of these vessels across the Atlantic, which means a merchant navy personnel of 35,000 men. In all probablilty the officers can be recruited from our present merchant marine, where even third mates frequently have masters' certificates. But trained engineers, gun crews, deck hands, wireless operators, and sailors are not to be found in any such quantity as is needed, particularly in view of American shipping laws which have awkward restrictions as to the nationality of officers and crews. It is, perhaps, not impossible that these laws may be modified, if the need is demonstrated, as an emergency measure. Another possibility is the establishment of merchant marine training "camps"—the camps probably to be the first vessels of the emergency fleet to be launched, to give intensive training in the several branches of sailor's work to those young men who prefer this variety of patriotic service to other branches of Uncle Sam's Army or Navy.

Coöperation Between Business Men and the Schools

By Benjamin C. Gruenberg

FROM an era of utter scorn on the part of the business man and indifference on the part of the educator, we have evolved into one of mutual aid that promises to give vitality to schooling and efficiency to business. The "Cincinnati Plan" of vocational education, as described editorially in THE SCIENTIFIC AMERICAN for June 26th, 1915, has been extended and adapted to a large variety of situations, and has shown itself sufficiently plastic to fit into the training of commercial and mercantile workers as well as of mechanics and engineers. In New York City, where in February of 1915, the plan was introduced into a number of high schools, there are at present over 100 firms and corporations coöperating with the public schools in the training of about 500 students.

The fundamental idea in the plan is to utilize business *equipment* and business *experience*, whether in shop, office or store, for educational purposes. It is out of the question for the schools to maintain complete and up-to-date equipments in the various lines of technical activity; and it is quite impossible for them to carry on their technical instruction under the ordinary business conditions. It is equally impossible for the work of the business establishment to be interrupted for the purpose of giving instruction to beginners. Under the coöperative plan each establishment makes its appropriate contribution to the training of the young workers, with a minimum of cost and a maximum of return.

At present all the students receiving training under the coöperative plan are supposed to have completed one or two years of a high school course—commercial or technical. The balance of the course is spent partly in the school and partly in the shop or office or store. The time is usually one week, but should need arise this may be changed to suit special conditions. The students are assigned to their work in pairs, one of each pair attending school while the other is at work. The students receive the usual rate of pay for the time they spend at work. The school activities are coördinated to the work, and the latter is analyzed for the purpose of finding the most profitable arrangement of processes and operations, from an educational viewpoint.

Of the 500 girls and boys now studying under this system of coöperation, some are learning the machinist's trade, some business organization from the side of the administrative office, some the publishing business, some retail selling and some are becoming high-class dressmakers. A number of the large public service corporations are working out details for coöperation with the public schools, and will probably start in the near future. Many large employers of skilled labor are mourning the death of the old apprenticeship system while their rivals in business are adopting this coöperative system and through it solving the problem of training their workers for present-day conditions.

This brings us to the chief difficulty encountered in developing the plan in a comprehensive way. It is not necessary to go to the High Schools to secure workers who can perform simple mechanical operations. It is necessary, however, to go there to get workers capable of looking beyond the mere performance of these operations, of comprehending their relations to one another and to the business as a whole, of meeting intelligently the thousand and one emergencies that are constantly arising in the factory. Unfortunately, most employers and managers have not the imagination to foresee that

(*Concluded on page 500*)

Recent Chemical Developments

More Fish

By Ellwood Hendrick

PROTEIN is the name given to a group of bodies needed for human food. They are very complex, and aside from the fact that they contain nitrogen, we shall say no more about their chemical nature. Other classes of foods do not of necessity contain this element, and yet we must have it, in proteins, to live.

We get proteins when we eat meat, beans and fish. It is not to be found in appreciable extent in other vegetables than in the bean family. Meat is the usual way we get it, if we can afford it, but there is not enough meat to go around. Beans are plentiful and could be made much more so if the soya bean were introduced, but the art of cooking has not advanced enough to make them acceptable as a steady diet. Then comes fish, and concerning fishing, we may say that in the art (which needs no change) and in the craft and business (which do need change) we are still medieval.

When we consider how a beef critter or a pig is utilized in the stock yards and packing houses, and compare that with the happy go-lucky A. D. 1492 Portuguese methods of the fish industry, it seems as though it were about time to sit up and take notice. The sea is still there and there are a great many things besides submarines in it. Very few of us really know anything about fish, and a talk with one of those rare men who have studied the nature of fish and their ways, as a science, is one of the most illuminating of adventures. Single fish lay millions of eggs at a time, and there is a renewable supply of protein in the sea for all the world.

I said that in fisheries we were back in 1492. It may be necessary to modify the statement a little, just to save my face. There are steam trawlers and steam drifters and they have increased the cod and herring catch. And here and there the edge of the cover of the greater value of fish is being lifted. Here and there, too, we find men who have been working on the industrial problem and men of science who have been engaging in the pioneer work that precedes better conditions. The use of fish oil in the paint industry has been for a number of years an accomplished fact. Fish oil is also hardened, turned into a solid fat by means of hydrogen, and lo and behold, it loses its fishy smell in the process and becomes as good for cooking as beef tallow or hog lard! But this does not give us protein; the protein is not in the oil.

In order, however, to make fish economical and to bring it to us, these side lines must be prosecuted so that in the end, the protein may be cheap. One producer seems to be pointing the way of advancement. If there are others it will be good to hear from them. This concern treats the cod family, which may be regarded as the beef of the sea, while herring have been referred to as the pork. The meat is made into boneless cod, the livers are cooked and pressed and the oil from them is refined by the Baskerville process into the highest grade of medicinal product. The skins are converted into high-grade glue and successful experiments have already produced a very fine quality of leather, while the fins and bones and residue of the skins and livers go into fish meal. This the United States Bureau of Agriculture is earnestly urging farmers to use as poultry and cattle feed. It furnishes protein for live stock. The menhaden oil pressers might produce a great deal of fish meal, but it is easier to sell the pulp for fertilizer, for which there is always a good demand. This is natural because fish fertilizer contains fixed nitrogen in abundance; but why use a good stock feed for manure? That's what we're doing, though.

Heads as well as bones are useful for glue, and the demand for glue is so great that it seems a shame to waste this good material which may be made available in many industries by scientific and intelligent handling. In 1914 the United States consumed $12,000,000 worth of glue.

The fishing industry has odd troubles, and one of them is bait. There is plenty of bait and there is great demand for it, but merely because of lack of business coördination and the expenditure of some capital in the right place, bait is scarce and high and wholly unprocurable at times. This may be remedied, and I am informed that measures are under way to do so. One trouble with the bait problem is that it has been made a subject for diplomatic discourse and convention rather than a riddle for science and business to solve.

The catch of cod, haddock, hake and pollack has increased every year but the price of fish has gone almost beyond the ability of the packer to buy. Codfish, skinned and boneless, has risen from ten to twelve cents a pound ot only a few years ago, to twenty and twenty-five cents now The tonnage, however, could be greatly increased. The cod is there.

The annual European catch of herring was approximately six million barrels before the war. Thirty years ago Great Britain produced about 800,000 barrels per year, against 4,500,000 barrels in 1914. There are odd twists in the herring trade. Orthodox Jews in Europe and America consume a great part of the British, especially the Scotch, cured output, while Germans, Poles and Scandinavians take the Dutch and Norwegian cures. There is an abundance of herring along the Atlantic coast of America, but the annual catch, exclusive of sardines, does not exceed the 250,000-barrel mark. The only apparent reason why this is not greater is that we don't seem to have got around to it yet.

As with meat, so with fish; the demand is greater than the supply. The meat industry is coördinated and economical in its practices. The trouble is the lack of raw material; of meat on the hoof. This is not the difficulty with the fisheries. The raw material is at hand; the fish are in the sea. The troubles are, bait, coördination, scientific procedure, refrigeration, transportation and the utilization of waste materials. I am not posted on the salmon industry of the Pacific coast, but from all I can learn of the cod and herring industry of the all-American side of the Atlantic, it needs shaking up. We do not need a trust formed after the manner of the palmy days, with preferred stock given for any old shacks on the shore and common stock "floated" in the air. But the time is ripe for men of substance to begin at least tentatively, the greater development of the fish industry so that under enlightenment and the guiding hand of men of science, coupled with good business methods, their ships may multiply, the while they feed the people.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

American Shipping and Foreign Trade

To the Editor of the SCIENTIFIC AMERICAN:

In the reading room of this hotel I picked up your issue of February 17th, 1917, and was much impressed by the article by Prof. G. A. Aerts entitled "One Phase of Our Commercial Preparedness." Having traveled for several years through South America and lately through Japan and China, I can testify to the accuracy of many of the statements in the above article, and I can add that only this week another steamship line was decided upon to link China and Japan with the West Coast of South America.

I have found many Japanese manufacturers thoroughly inbued with the determination to win the trade of South America, and I regret to say that my experience leads me to expect that they will succeed in many lines.

I set myself the task of finding out why this should be so, and although I have not yet finished my researches, there are several reasons that stand out so prominently that I am tempted to add my humble note of warning to our American manufacturers.

One of the most important levers used by the Japanese is the question of freight rates, and I will quote my own experience:

I have been paying $50 a ton for a certain line of goods from Antofagasta, Chile, to New York, whereas I can ship the same ton from Shanghai to New York, via the Panama Canal at less than $40. Why is this? The answer can be found at once by any one who reads the American shipping laws, and unless the new Board which is to control American shipping interests takes immediate action and leaves discussion to the ever present "kickers," the American manufacturer will find himself against a stone wall of Japanese foresight and cheap freights.

I know exactly what I am talking about when I tell you that the American manufacturer must be given an abundance of American ships whose freight rates are as much under control as those of our Interstate railways, so that they can be forced to carry American goods at a competitive cost, and if the argument is advanced that American ships with American labor cannot compete with the Japanese, then I solemnly warn the Congress of the United States that a way must be found to produce these competitive ships even if every one of our citizens has to contribute a *pro rata* of the expense in the form of extra taxation.

One more warning will I give, and that applies to awakened Russia: This country is advancing at such terrible strides that even five years from today her imports will have outstripped imagination. Let our Shipping Board carefully consider how this Russian giant is to be fed millions of tons of American goods, and let the decision be put into practice within six months at the latest.

I have my theories on how this should be done, but I feel they are too humble to be offered to men of such marked ability as constitute the newly created Board; but to American manufacturers I will say, "Watch Russia carefully."

There is a paragraph in Prof. Aerts' article, that I would challenge, wherein he states that American goods can be duplicated in Japan and then sold in South America. Now, I happen to know that this cannot be done if the American manufacturer has protected himself by patents and trade-marks in South America. Part of my work has consisted of running down infringements and bringing suits in the South American courts, and I must say that with the sole exception of Chile, I have won every case, and have found the laws fully ample and the courts anxious to do full justice to the legitimate manufacturer. In several of those countries the holder of the registration has the right to confiscate an imitation wherever found, even at the customs house.

Even in Chile there is now a bill before their Congress to amend the law so as to give full protection. The trouble has been that the law was so worded that the courts held that an article was not an infringement unless it was a perfect reproduction of the article imitated, but this is taken care of in the new law, which I helped to frame while in Chile.

I think it would be bad policy to allow Prof. Aerts' suggestion to go unchallenged as leading our manufacturers to believe that it was a waste of money to take out patents and trade-marks in South American countries. My own experience shows that the very opposite is true, and I have had ample opportunity to test those laws.

E. C. DE VILLAVERDE.

Astor House Hotel,
Shanghai, China.

The Shadows of Jupiter

To the Editor of the SCIENTIFIC AMERICAN:

I was one evening gazing absently at the stars through the window of my room, when my attention was suddenly caught by the appearance on the window-pane of shadows the like of which I had never seen before. They outlined very clearly part of the uppermost branches, with leaves and thin boughs, of a tree 90 feet high and at a distance of more than 100 feet. The window-pane was in that part covered by a thin layer of very small drops of water; the blurred image of Jupiter, surrounded by a halo of perhaps 6 inches diameter was visible through this translucent screen and the field of vision where the shadows appeared consisted of that spot illuminated by the planet. Despite the enormous distance the shadows possessed the same degree of sharpness as cast by the sun or moon at a distance of between 2 or 3 feet. I had not studied the phenomenon long before I noticed another remarkable feature: that was the great speed with which they moved through the field of vision. A leaf, for instance, would emerge in the upper right part, traverse the screen with a speed of 1 inch in 8 seconds and disappear in the opposite part. It was fascinating to watch this parade of shadows.

It is probably the only way to *see* the rotation of the earth without costly instruments.

I made at once a practical application of my discovery. There was a high spruce whose topmost shoot I wanted to measure. I moved in such a position as to see one end of the shoot projected on the screen, marked the place where it appeared, then did the same with the other end; the distance between the marks was the dimension wanted.

I have not yet had time to try other screens and luminaries, but think that Sirius ought to be as efficient as Jupiter. W. S. GRIPENBERG.

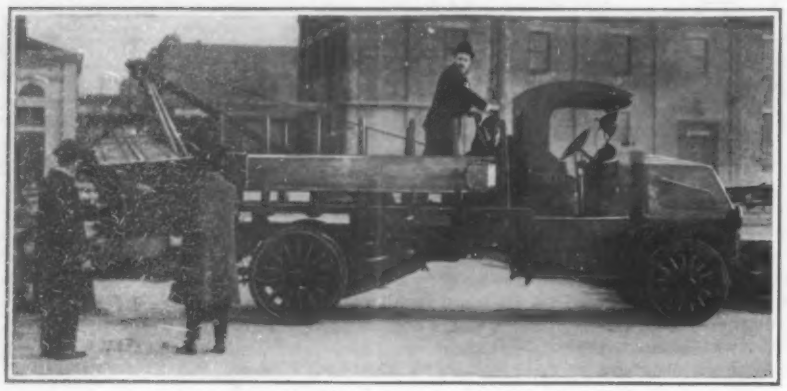
Masaby, Finland.

Fighting Submarines from the Air

To the Editor of the SCIENTIFIC AMERICAN:

It seems to me that the only efficient way to deal with submarines is from the air. Consequently, every merchant ship should carry two or more hydroaeroplanes on inclined boards from which they could immediately slip into the sea and then take flight and throw bombs on the sighted submarine, and that the submarine chasers should be nothing else than swift small motor boats, simply fitted as hydroaeroplane carriers.

New York. H. MARCHISIO.



Motor truck loading itself by means of a derrick

Hauling up a sewer pipe by means of the truck's own power

Mechanical Aids In Loading and Unloading Trucks

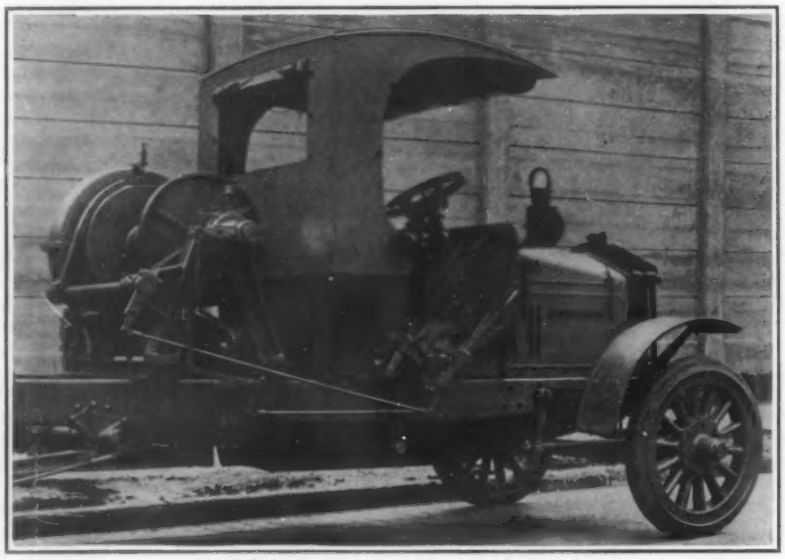
Reducing to a Minimum the Idle Hours of a Commercial Motor Vehicle

By John S. Harwhite

THEORETICALLY a motor truck will replace as many horses as its power, speed and carrying capacity will permit. Thus, if one horse is able to haul two tons at an average rate of three miles an hour, and a four-ton truck can run at twelve miles per hour, we see that, *when operating*, the mechanical conveyance will replace eight horses. But note those italicized words "*when operating.*" No matter how excellent the material, design or workmanship entering into the construction of a truck, it is only when the vehicle does useful work that advantage of any of these qualities can be obtained. And standing still, assuredly, doesn't represent useful work. A team of mules can stand still at a loading or unloading platform almost as efficiently as an inert motor truck, and therefore the greater amount of standing still, the more closely does the motor truck approach the efficiency of the horse or other draught animal.

Transportation managers and truck designers have, therefore, concentrated their efforts on the installation of devices which will reduce to the lowest point the inactive time of motor trucks spent at loading and unloading points. In many instances they have borrowed a leaf from the book of the builder of the horse-drawn coal truck and have included the hand operated dumping and elevating devices used for the quick discharge of a load of coal. It is but natural, however, that the actual lifting of a load weighing two or more tons, requires such an amount of mechanical reduction, in order to obtain the necessary power, that the time consumed closely approaches, in some instances, that required by two men with shovels.

One of the chief advantages of a motorized hauling system in this connection lies in the power which the engine or electric motor is able to exert while the truck itself is standing still. It is this power-producing ability which is the basis of many of the most ingenious schemes designed to facilitate loading and unloading. For example, in the rear dumping type of coal dealer's or contractor's truck, a long vertical cylinder located directly at the rear of the driver's cab is used as the basis of a powerful hydraulic pump, operated by a special gear or clutch which may be thrown in mesh with the main shaft of the transmission. The forward, movable end of the dumping body is attached to the piston which operates in this cylinder and which is forced upward as the oil is pumped. Naturally, the operation of a lever, which releases a valve holding the liquid in the cylinder, allows the unloaded body to descend rapidly but gently to its proper place on the chassis.



Powerful winch mounted on a motor truck

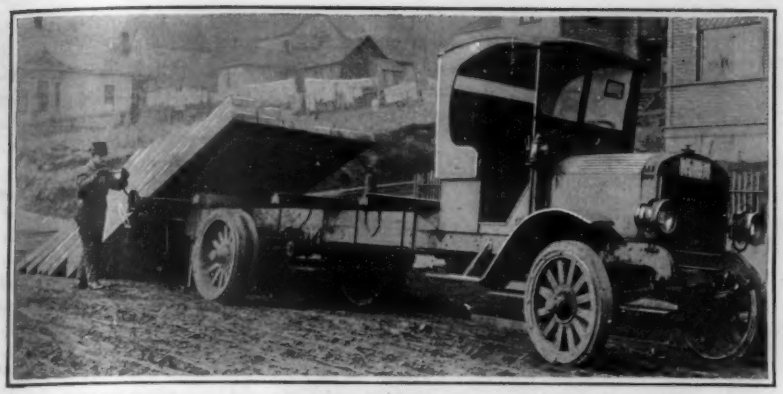
The same effect may be obtained by other devices which consist of a rigid upright and system of chains and pulleys operating on a winch or drum driven by the same transmission or clutch shaft.

Probably one of the most useful devices on coal trucks is that which combines both the elevating and tilting principles. The tilting body, it will be understood, is employed generally to obtain quick discharge of the load to a point on the ground, or lower. If the chute through which the coal is to be delivered, is long, as in the case of a coal window set a few feet back from the curbstone, the inclination will not be sufficient to enable the coal to slide, unaided, to its destination. Under these conditions it is necessary to elevate the body as well as to tilt it, so that the load will not only follow the force of gravity and move toward the rear of the body, but will start from a point sufficiently high to cause it to slide rapidly down the chute. To lift from two to six tons bodily into the air, and then to tilt this to the proper angle, requires more strength than two average coal drivers should be expected to exert. Through the medium of engine-driven gears, however, acting on a set of X-shaped legs, the entire load may be raised and tilted to the proper inclination in a few seconds, so that, not only can the load be delivered to a coal window several feet away from the truck but the clearance will be sufficient to enable the chute to pass over a picket fence of the ordinary height.

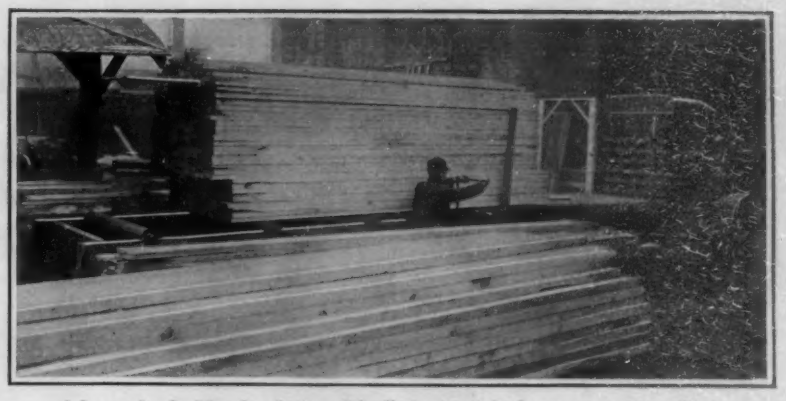
Methods which provide for rapid unloading however, scarcely serve to solve loading problems, for it is obviously a more simple matter to slide a load out of a truck, than it is to lift it in. Therefore, even more ingenious are the devices intended to facilitate the rapid loading of motor-driven vehicles. To follow the above mentioned type of coal truck to the point where it obtains its load, we find that some form of chute from an overhead bin, crane-operated

A derrick on the truck is invaluable for laying trolley tracks

Coal truck body lifted so that the coal will pour down the chute



A hand operated roller facilitates the discharge of a lumber load



A heavy load of lumber being slid off the truck body upon a roller table

bucket, or a scoop with mechanical conveyor, is invariably used. Such devices are, of course, operated by gravity or by power, separate from that developed by the truck engine. A semi-mechanical device has recently been installed with great success by several coal companies, which have found that demurrage charges for loading coal cars can soon amount to more than the profits of the transportation of many tons of coal. This device consists of tilting hoppers mounted on horse-drawn trucks, which are moved alongside the freight car which is to be emptied. These hoppers are filled by laborers, while the trucks are making a previous delivery, and are then dumped almost instantaneously into the trucks when they return empty. The mobile design of these hoppers enables them to move easily from one freight car to another.

The elevation of a coal truck body is not the sole work that can be accomplished by the properly installed power-operating drum or winch. Large bulky loads, such as heavy steam boilers, structural steel, and the like may be loaded by the truck's own power, if the cables or chains are connected in the proper manner. For example, two uprights, in the upper ends of which pulley blocks are fastened rigidly, and secured to the frame of the truck, can be used as a means of directing the cables passing around the drums in the proper direction to roll any large cylindrical object up the incline leading to the truck. Or, the pulley may be mounted in uprights and supports extending over the rear of the truck to form a derrick, and thus heavy loads of structural steel may be moved about a factory yard with surprising facility. A somewhat more elaborate system of this kind is used by many lighting companies for the installation of telegraph poles, lamp posts and the like. An upright to form a derrick extends from the rear of the truck while a cable passes through the pulley located in the top of this upright and is wound around the motor-operated winch. By this outfit, a large telegraph pole or lamp post can be brought to an upright position, raised above the ground and so maneuvered as to be set easily and gently into the hole previously dug for it.

Probably one of the most difficult problems which has been presented to the truck designer to solve is that of the successful handling of loads of dressed and undressed lumber. Lumber is, at best, a bulky material, requiring a length of wheelbase not always found on the average truck. Because of its very length, however, such a load lends itself especially well to the use of rollers, both for loading and unloading. The use of these rollers, placed transversely on the frame of a truck, enables a previously made-up load of lumber to be slid or rolled directly on the truck body with little effort. If one or more of these rollers is made to revolve, the load can be discharged to the point where it will tilt backward, with the rear end resting on the ground. If the truck is then moved slowly forward, the entire load may be discharged in a few moments. Many lumbering companies handling material which would be injured by the above-mentioned rather violent method of discharge, have devised small platforms on which the finished lumber is mounted and which may be lifted directly upon the truck over channel rails provided for the purpose. These platforms are loaded from benches constructed at exactly the proper height, so that the lumber may be moved straight on to the truck body. In the case of lumber which is so long that the rear end requires support in addition to that provided by the truck body, the semi-trailer on which the rear end of the load rests may be used. This semi-trailer consists of only two wheels and an axle, connected by means of a tongue to the rear of the truck.

Saving the time of loading and unloading by the use of interchangeable bodies which may be raised bodily off the chassis

Because lumber is bulky, rather than heavy, it has often been found advisable to employ four-wheel trailers in addition to the load carried on the truck itself. There may be two or more of these trailers to each truck, one set being loaded while the other set is being transported to its destination.

For material which cannot be loaded quickly, the movable crate or body section has become almost indispensable. Such a system involves practically the use of two bodies, one to be loaded while the other is carried to its destination and its load discharged. Such a system is especially useful in the case of the department store or other business having occasion to deliver breakable material which cannot be loaded in bulk. These movable crates, or bodies, may be supplemented by apparatus designed to facilitate their transfer to the truck. With such a system a body, loaded with two or three tons of packages of miscellaneous material, may be placed on a truck and the truck started on its destination within two minutes. The time consumed by the truck in reaching the distributing stations, or other destination of the body, discharging, and returning for a fresh load may be spent at the warehouse or other loading point in carefully packing, in order of delivery, another miscellaneous load.

An elaboration of this system is found in the movable crate or body which in itself is subdivided into additional sections, each one of which may be loaded with material of a certain nature or with goods bound for a certain destination. For example, the department store delivering to a dozen substations may

(Concluded on page 503)

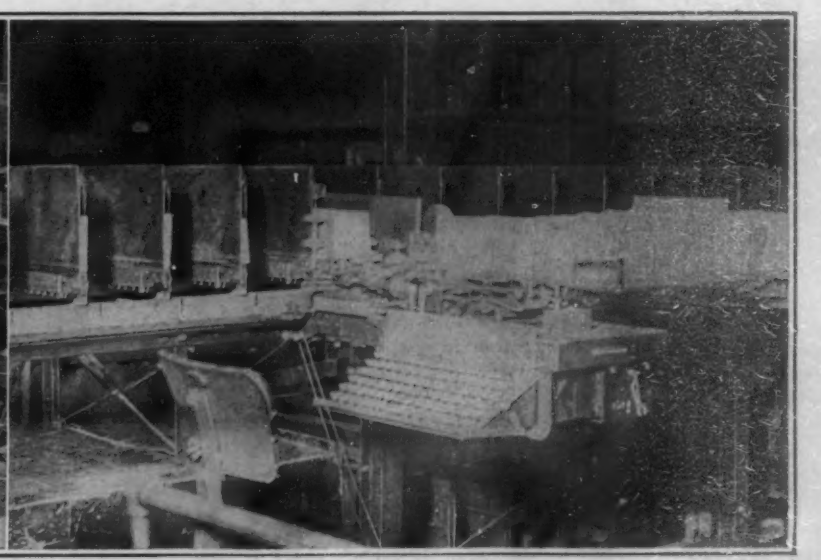
A Keyboard Machine for Sorting Letters

THERE has recently been developed and is now in use in the Chicago post office, a machine which, both in its manner of working and in its achievements, is to the business of letter distribution what the linotype is to the setting of type. The operator sits at his keyboard; the letters flit in single file across his field of vision; he catches the post office or address on each passing envelope, strikes the proper key, and the machine attends to all the details of conveying that particular letter to the appropriate compartment, where it joins other letters having the same destination or routing.

As our cut shows, in addition to the rank of compartments into which the letters are to be distributed, the machine consists of two essential parts—the keyboard, and the erect carriers attached in a long series to the endless conveyor belt that passes over these compartments and back again under them. Each carrier has a row of triggers along the bottom, and at the upper edge of each compartment stands a tripping mechanism. This mechanism occupies a different position on each compartment, while all the separate triggers on each carrier are independently adjustable. The letter drops out of the carrier only when all the triggers that have been set are tripped; and of course it is possible to set

(Concluded on page 503)

Sorting letters by machine in the Chicago Post Office



Close view of the keyboard of the letter sorting machine

Plants That Water Themselves

AN English correspondent points out a neat scheme for saving the horticulturist's time by making his plants water themselves. The pots are arranged about a large central bucket which is kept filled with water. Strips of flannel are placed with one end in this bucket and the other embedded in the soil of the pots. By capillary action the water passes along the flannel and eventually reaches the pots, keeping the soil moist to the exact degree demanded by the varying nature of each plant, and maintaining this moisture for a long time without other attention than refilling the big bucket.

A Squash That Grew With a Force of Two and One Half Tons

AN article in a recent issue of the SCIENTIFIC AMERICAN SUPPLEMENT recalls to the writer a most interesting test of the power latent in a growing plant, made at the Amherst Agricultural College so long ago that it is probably old enough to be new again. A young squash vine was selected and placed under conditions most favorable for growth. A flower was fertilized, and when the young squash was well started it was placed under a steel harness and in a wooden cradle in such fashion that its expansive force was free to play against a lever, while the squash itself was protected from crushing under the weights which it was expected to raise by means of that force.

The irrigating tapes of flannel that keep the pots supplied with moisture

A group of self-watering flower pots fed by capillary action

Our cut shows the general arrangement of cradle, harness, squash, lever arm, fulcrum and weights. At first an iron bar one inch square was used as a lever; then a larger bar of steel, then a chestnut plank, then one of seasoned white oak, and finally a chestnut block five by six inches and nine feet long; but even this had to be strengthened by a plate of iron four inches wide and half an inch in thickness. The fulcrum was also renewed from time to time, as the weight increased.

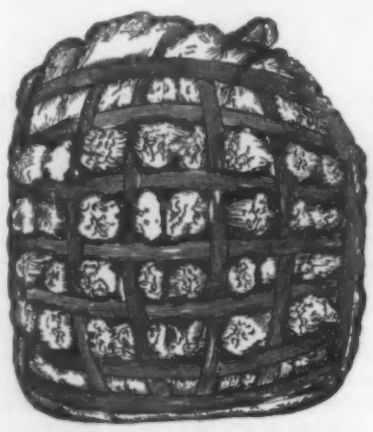
The following table shows the incredible mechanical energy developed by the growth of this squash:

Aug. 21	60 lbs.	Sept. 13	1,200 lbs.
23	69 lbs.	14	1,300 lbs.
23	91 lbs.	15	1,400 lbs.
24	162 lbs.	27	1,700 lbs.
25	225 lbs.	30	2,015 lbs.
26	277 lbs.	Oct. 3	2,115 lbs.
27	356 lbs.	12	2,500 lbs.
31	500 lbs.	18	3,120 lbs.
Sept. 11	1,100 lbs.	24	4,120 lbs.

In addition to this, it was recorded that on October 31st, when the harness gave out under the strain, a weight of 5,000 pounds was raised sufficiently to make it clear that with proper support even this would have been carried by the squash. It was not feasible to remove the harness and substitute a new one, because it was embedded in the squash, which had grown up through the meshes of the harness in protuberances an inch and a half high. When on November 7th the harness was removed to take a plaster cast of the squash, it had to be cut into small pieces with a cold chisel and drawn out sideways.

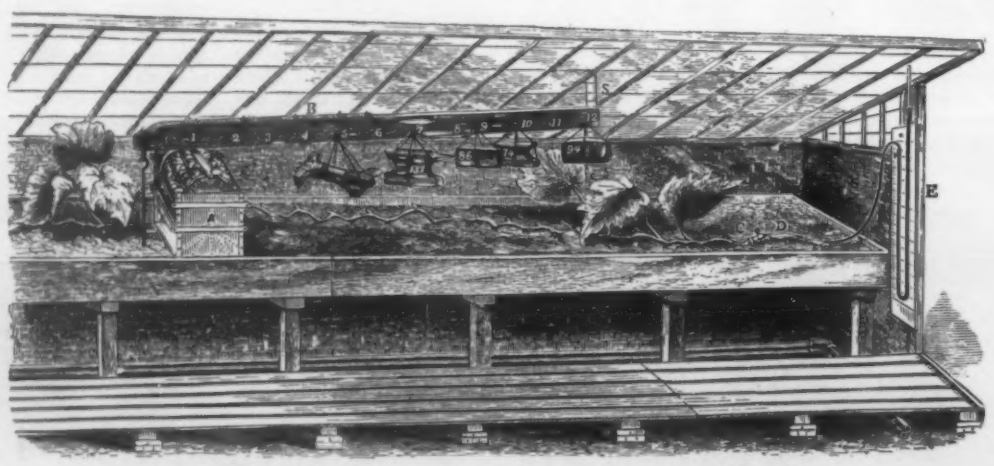
It was stated in the official report that the lifting power was greatest after midnight, when the growth of the vine and the exhalation from the leaves were least. Scarcely less astonishing than the mechanical force exhibited was the ability of the tissues to resist chemical changes and the attacks of mold, where the rind was injured by bruises or cuts. Whenever fresh-growing cells were exposed to action of the air, they immediately began to form a periderm of cork, precisely resembling in appearance and structure that produced upon the cork oak, the elm, and other trees.

The form of the squash when finally relieved from its labors can hardly be described, but is sufficiently plain from the cut. The radial objects below are the boards of the cradle, at the top is seen the harness. The weight of the squash was stated as 47 pounds, with a rind about three inches thick. The very small internal cavity contained seeds, apparently perfect and in normal numbers.



Top view of squash in its harness

End view of squash, showing harness above and cradle beneath



The squash in its cradle, and the lever bar by means of which its growing force was tested

When we contrast the normal texture of the squash with that of tree trunks and roots, and cast our eyes upon the table showing the growing force of the former despite this apparent disadvantage, it is not to be wondered at that growing trees displace the best laid pavements and are able to disrupt rocks and buildings if once they can gain the entering wedge.

The Prolific Soya Bean

THE soya bean is one of the most promising of vegetables. It provides oil and food for man and beast. Given enough soya beans and granted the art of preparing them so developed that they might be served as food having sufficient diversity and palatableness, neither meat nor fish nor fat would be needed. In this respect the Germans did not prepare for war and a blockade.

It is marvelously prolific, and so valuable is the oil expressed from it that nearly every State in the Union is making experiments with soya beans in its agricultural experimental stations. The oil is used as a substitute for linseed oil which, owing to the uncertainty of the flax crop, is more speculative than mining stocks in its value. The oil may also be hardened into an edible, hard fat, while the pulp or oil cake is one of the very best kinds of cattle feed.

In order to get as much as possible of the oil out of the meal the pressed pulp is sometimes further extracted by means of a solvent which will dissolve out the oil remaining after the beans have been pressed. Naphtha is good enough, but care must be taken to remove it entirely from the meal. Cattle do not take to the smell of naphtha, although they thrive mightily on their new fodder when it has been thoroughly removed. Now tri-chlor-ethylene is another good solvent for soya bean oil; it is not offensive in odor and it is not poisonous when given to cattle in comparatively large doses. It is neither inflammable nor explosive. Off-hand, it would appear that tri-chlor-ethylene was better and safer in every way than naphtha, but it appears that when it has been used as a solvent for the oil in the pressed meal of cake a considerable number of cattle have died from eating it. Now since the cake is grand feed for cattle and the tri-chlor-ethylene is not poisonous, something must have happened, and it appears probable that a chemical reaction takes place between these two harmless bodies which produces a poison. It is not known what the reaction is.

The Current Supplement

THE discovery of the X-Rays was a matter of very considerable value to science in many directions. A review of the subject, including modern methods of employing these rays will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2159, for May 19th. Such a large proportion of the world's supply of optical glass, and lenses for all kinds of instruments, has heretofore been made in Germany that, outside of that country, there has developed a great dearth of many kinds of optical instruments, which has been greatly intensified by the demands of the war. All of the Allies are in great need of field glasses, range finders, photographic lenses and sextants, as well as many other instruments, and all questions relating to the manufacture of the glasses required are just now of great importance. In this connection the elaborate article on *Glass Grinding and Polishing* will prove of special interest, especially as it is accompanied by a number of cuts illustrating the author's theories. *The Training of the Chemical Student for Work in the Factory* is a subject of wide importance in connection with the problem of commercial preparedness. *Gathering Turpentine* discusses the conservation of a material widely needed in shipbuilding operations. The article is illustrated by a number of excellent photographs. *Timber Decay* discusses matters of importance to the engineer and the architect. Most people suppose that nothing can exist in the frigid regions of the poles, but that they are by no means barren of life is disclosed in an interesting article on *Life on Glaciers and Snow Fields*, which tells of many animals and plants that thrive there. Sketches of some of these forms are shown in an accompanying cut. *A New Use for Old Lamp Bulbs* tells how to make a simple and useful thermostat, and gives an explanatory cut. *Calico Printing* reviews the origin and development of a world-wide and ancient calling. Other articles include *The Septic Problem of the War*. *The Perception of Flashes of Light* and *Molds That Injure Paper*.

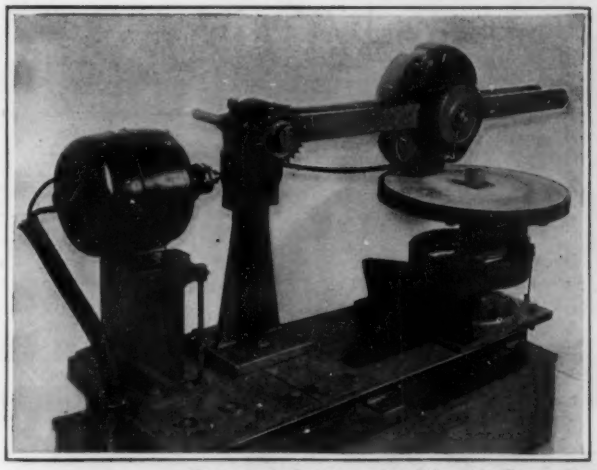
Durability of Concrete in Alkali Waters

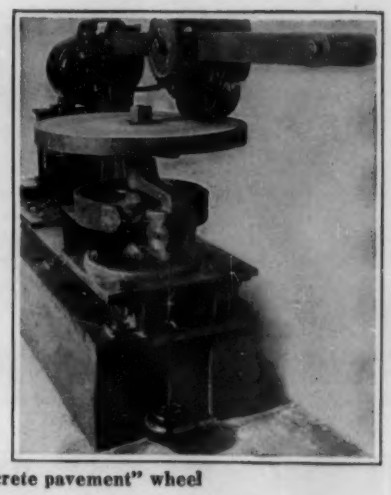
BECAUSE various branches of the Government use concrete in irrigated districts, where the alkali occasionally becomes concentrated in the soil, the Bureau of Standards undertook in 1913 an investigation of the durability of concrete in alkali waters. The work has been carried on in coöperation with the Reclamation Service, the Department of Agriculture and the Portland Cement Association. Some 8,000 specially prepared draintile made under the Bureau's supervision were installed in concentrated alkali soils in the western states, and a number of these have been taken up and tested each year. More recently a number of concrete blocks have been made, using aggregates now in use on different irrigation projects, and installed in alkali soils. These are to be examined from time to time for indications of disintegration. The results thus far available show that concrete and cement draintile will disintegrate in some of the soils where they have been tried unless made with the greatest care and of the best materials.

Testing Leather for the U. S. Government

By C. H. Claudy

THE testing of materials prior to adoption or use is an important part of the work of many industrial establishments. Material tests are also conducted by the United States Government at the Bureau of Standards. In many instances, such as steel and concrete column work, the tests give an exact index of the strength of the material under actual service conditions. But for some less solid materials it is difficult to plan tests which will reproduce service conditions with sufficient accuracy to be satisfactory as indicative of the real value of the material.





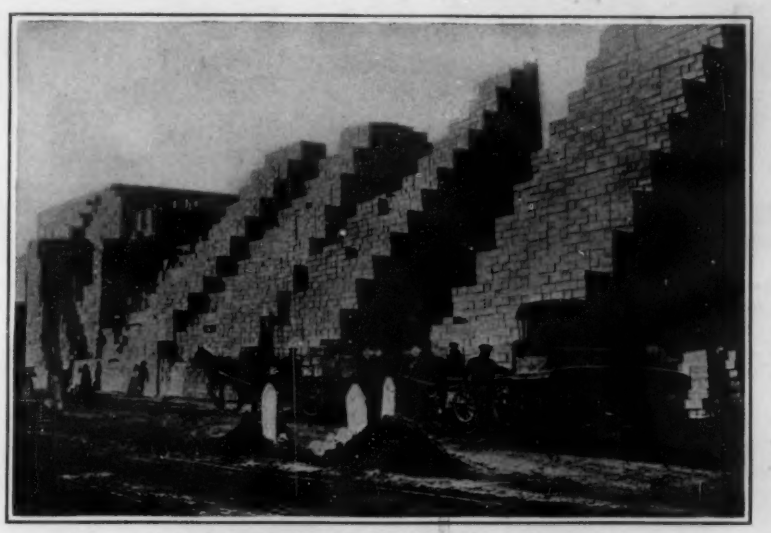
Giving sole leather a "walking test" on a "concrete pavement" wheel

Automobile tire manufacturers have tried for years to devise a testing engine which would simulate road conditions well enough to make its tests of value in drawing up specifications for tires. The majority of such machines have gone to the scrap heap. No tire testing engine yet devised is sufficiently flexible to simulate road conditions. Most tire manufacturers now depend upon actual wearing of tires on the road for the answers to the questions they ask in regard to durability and construction.

Leather is a material of great importance to the United States Army. Comparative leather tests have, so far, been difficult to make. Army shoes are bought according to specifications which may demand, for instance, "the best grade of oak tanned leather for the soles." Oak tanned leather in the leather trade is supposed to be the best and most durable of sole leathers. It is perfectly possible to distinguish between several samples of leather by chemical analysis as to whether one or all are oak tanned, but the results do not indicate whether "oak tanned leather" is really the best wearing or, of two samples, which one is superior.

Leather manufacturers and shoe makers have endeavored to satisfy themselves in regard to the wearing qualities of leathers by subjecting the material to an abrasive test. By holding leather samples of known weight for a definite time upon an abrasive wheel revolving at a known speed, the amount of wear is easily measured by weighing the samples after the treatment.

(Concluded on page 508)



A food distribution depot "somewhere in France"

Photo by Underwood & Underwood

Powerful telescope used on the battleship "Pennsylvania"

Wartime Wireless Apparatus for Use on Land and Water

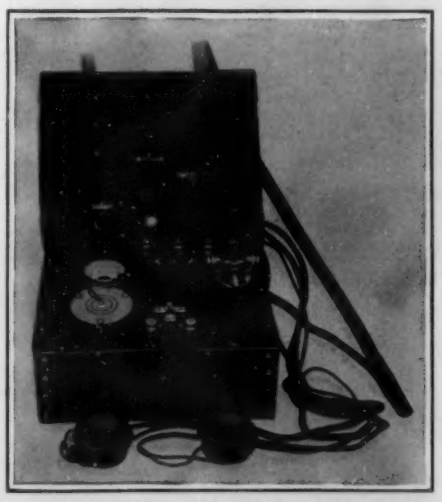
IT is still too soon to know what the present war has meant in the development of wireless telegraphy; although such news as has been allowed to filter through the censors tells of remarkable improvement in many directions. However, one of the ostensible results of the war is to be found in the appearance of compact, efficient sets for use on board aircraft and submarine chasers, and as a means of communication for artillery officers and advance patrols in military operations. Indeed, never before have sets been built, which, considering their range, required so little power.

Intended particularly for service on board submarine chasers, where the only current available is that furnished by storage battery, a switchboard type of wireless transmitter and receiver has recently been designed by A. B. Cole of New York city. This wireless set operates on a 12-volt storage battery and requires current discharge of 5 to 8 amperes. It has a sending range with a 50-foot aerial, of 25 miles under average conditions in day time, while its receiving range is from 300 to 500 miles. The transmitter measures 12 by 20 inches by 5½ inches deep, and the receiver measures 9 by 12 inches by 5 inches deep. Aside from these two components, the set comprises an oscillation helix which is preferably mounted on the ceiling, a pair of telephone receivers, and a telegraph key.

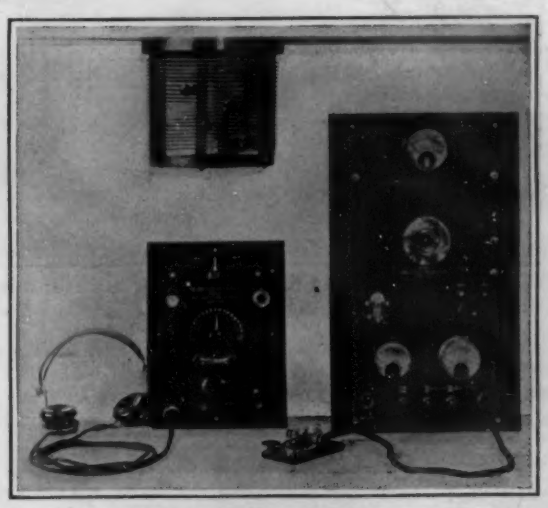
It is due to a novel transmitting system, which Mr. Cole has patented, that the remarkable ranges are obtained with an average input of about eighty watts. The transmitter pivots on an interrupter of special design, which has a normal high period of between 250 and 300 cycles and which is suitable for operation on 12-volt current. Through the combination of this interrupter and the specially-designed induction coil, a high-frequency musical note is produced in the distant receiver, and a much higher efficiency is claimed for this set as compared to other sets of equal weight. The spark gap is of rugged design and possesses a large cooling surface and radiation fin in order properly to quench the spark. Adjustment—which is seldom needed—is provided for by means of three machine screws so arranged that the sparking surfaces are kept parallel.

The receiving apparatus of the switchboard set is tuned by means of one variable condenser and one coil switch for all wave lengths between 200 and 1,200 meters. It consists of special inductance coils, a

(Concluded on page 508)



Portable wireless receiving set which weighs 20 pounds, 2 ounces



Switchboard type of wireless apparatus for use on motor boats. This station works on 12-volt batteries

Feeding the Armies

WHEN we speak so glibly of "feeding our allies" we do not always fully realize what a gigantic undertaking this is. Perhaps the picture presented herewith will bring home the enormous consumption of food which we must meet. This is not the headquarters for supplying all Europe, as might appear at first glance, but merely a distributing depot for a small section of the French front. Nor would the supplies shown here last long if not renewed.

Multiply these huge stacks of canned goods by thousands to make them cover the entire force of fighters and workers on and behind all the fronts, multiply them by hundreds to stretch them backward and forward over the whole period of the war, and some idea will be gained of the demands which war makes upon the agriculturist.

A 40-Power Naval Telescope

THIS illustration is of a 40-power telescope on board the battleship "Pennsylvania." With an instrument of this power it is possible to clearly distinguish objects at great distances. In fact, this is distinctly a long-distance glass. It can be mounted on the bridge, or in the fighting top (fire-control platform) and it is particularly suited to signal reading, to identifying an enemy ship by picking up details of its rig, armament, etc., which would not be discernible with a glass of less power.

The telescope is mounted pivotally on a stout cylindrical standard. It is elevated by means of a pair of levers, the operation of which will be clearly understood from the photograph. Traversing the telescope is done by means of a curved rest which bears against the body of the operator. The projection shown on the upper side of the telescope is a finder for enabling the operator quickly to bring the object within the field of the telescope.

Motor Tractors and Trailers

Using the Motor Vehicle as a Locomotive

By Joseph Brinker

MOTOR tractors of today are based on the age-old principle that a man or beast of burden can pull more than he can carry on his back. This principle dates back to the time when the savage man first carried a load on two sticks tied to the back of his horse with the free ends trailing on the ground. This was the beginning of the first trailer. This crude contrivance in turn preceded one of the greatest inventions of all ages, the wheel, which enabled the animal to pull many times what he could carry. For centuries all animal transportation has been carried on with animal tractors and wheeled trailers.

The invention of steam as a propelling force for locomotives and long trains of freight or passenger cars and for the tug boat with its barges, was but a step in the development of the tractor and trailer in which the principle remained the same.

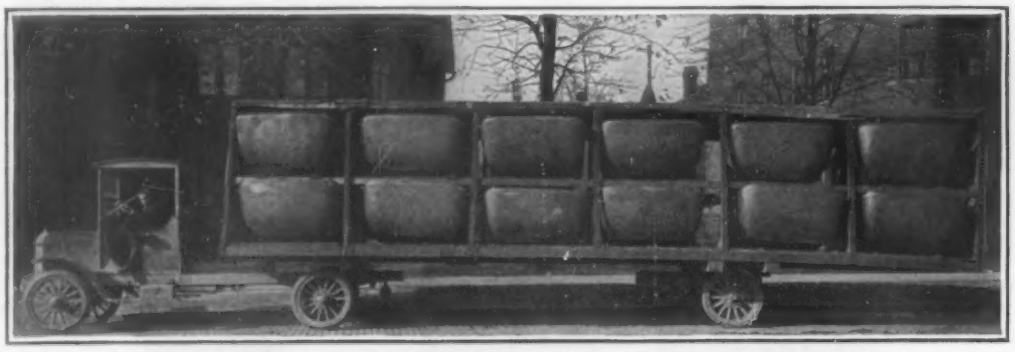
When the motor-propelled passenger vehicle became a commercial reality, owing to the development of comparatively light power plants and the invention of the differential gearing, it was but another step to the tractor of today.

The motor tractor of 1917 is essentially a vehicle of economy. Just as the horse of the savage pulled more of a load on the two sticks than he could carry on his back, so does the tractor of today pull more on a trailing wheeled vehicle than it can carry on its own chassis. This movement of larger loads has tended to decrease the cost per unit of load handled—hence the economy of the tractor-trailer outfit.

It must not be understood from this that the tractor-trailer unit is a universal road vehicle which if adopted generally, would solve all our vehicular transportation problems. While it is true that a tractor will haul behind it in a properly constructed trailer more than twice as much as the tractor itself can carry, other considerations such as rate of speed, grades to be encountered, and traffic congestion enter into the problem. Under adverse conditions, these three considerations may so affect the operation of the tractor-trailer outfit that it may prove less economical than the conventional motor truck, notwithstanding the former's ability to haul greater loads. The wise motor vehicle owner or prospective purchaser will do well to investigate and study all the conditions which his vehicles will have to meet before deciding upon the use of tractors and trailers.

The field of the motor tractor and the trailer must be considered as a whole, for either is of no value without the other. This field may be divided roughly into four main classifications as follows: 1—The haulage of heavy loads where speed is not paramount; 2—The haulage of bulky loads which when placed on the largest truck bodies are only a fraction of the capacity loads; 3—The haulage of loads that are extremely long, such as lumber and the like, which could not possibly be carried on the ordinary truck body and 4—Where the loading or unloading conditions are such that the loading time of the truck may be reduced by the use of two or more trailers, one in action behind the tractor while the others are being loaded and unloaded respectively at the points of pick-up and delivery.

In turn, tractors and trailers suitable for utilization in these four classes of work may be divided into another four main classifications as follows: 1. The tractor which carries none of the load on its own chassis, but pulls the entire amount on one or more four-wheeled trailers. 2. The tractor which carries its own capacity load as a conventional motor truck and, in addition, pulls a load of approximately the same or greater tonnage in one or more four-wheeled trailers. 3. The tractor which carries its own capacity load as an ordinary truck and additional load in a two-wheeled trailer, in which the load is balanced over the trailer axle and none supported by the tractor. 4. The tractor which has no load-carrying body, but supports the front end of a two-wheeled trailer in which the load is partly carried by the tractor frame and partly by the trailer wheels and axle. This type is ordinarily called the semi-trailer.



How the semi-trailer handles bulky materials; twelve automobile bodies at a single load

Special tractor truck with crane to hoist steel garbage buckets

Powerful modern road locomotive; driven by a 90-horse-power motor

Semi-trailers at the present time are in predominance in the trailer field because of their development from the horse wagon. In fact, a large proportion of the semi-trailers in use today are old horse wagons which have been partly rebuilt to withstand heavier loads and to stand up under the higher tractor speeds as compared with the comparatively slow horse travel. In such cases the conventional fifth-wheel of the old horse wagon is retained and supported on the rear of the tractor chassis, instead of the horse fore-carriage. Some of the chief advantages of this type are: Its cheapness for the man who wishes to change from animal to motor haulage and retain a portion of his old equipment; the ability for easy and quick maneuvering, such as backing up into narrow alleys or loading bays occupied by vehicles with small spaces between them; and the fact that the principal portion of the load can be carried on steel instead of rubber tires and thereby reduce tire cost.

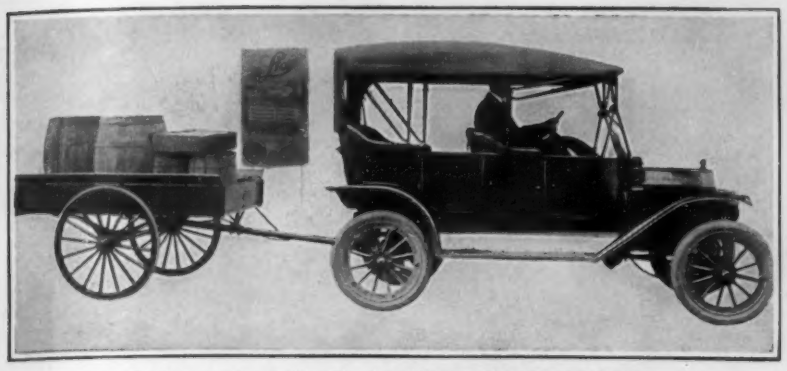
This type also has the advantage of being disconnected from the tractor by the use of jacks and a dummy fore-carriage, much like the front wheel set of a horse wagon, before the unloading operation begins, so that the tractor may back up under another semi-trailer, have the latter deposited upon its frame and be off on its next trip without the usual idle time incident to the loading and unloading operations.

Two of the greatest difficulties of semi-trailer operation are suitable trailer axle bearings to stand up at speeds of from 12 to 15 miles per hour, and the inability to keep the steel tires in place on the wood wheels at such speeds, especially when large loads are carried.

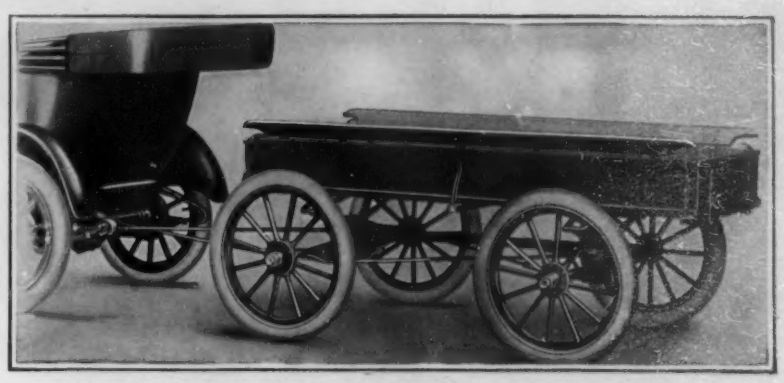
Roller bearings of the type commonly used on trucks have not proved satisfactory for heavy loads and better lubricated plain bearings have been devised to meet the requirements. Steel tires 10 inches wide are regarded as the maximum size that can be welded and shrunk on wood wheels to give good service without becoming loose and rolling off. While the merits of carrying the largest portion of the load on steel instead of rubber tires and the use of fore-carriages to eliminate the idle loading and unloading time of the tractor are important advantages, the necessity for jacking up the trailers to disconnect them from the tractors and the large loads carried per axle make semi-trailers difficult to move from point to point without a team of horses or other than manual labor.

These two objections are overcome in the four-wheeled trailer especially when used after a tractor which carries none of the load. In such a case the loaded trailer is merely backed up to the platform and unloaded while the tractor hitches to another trailer for the return trip.

The manufacture of the four-wheeled trailer for use in connection with motor-driven trucks and tractors made from motor trucks by shortening the wheelbase of the conventional type, began in this country in 1910 and 1911. The tendency in the design of such trailers is to build them from the motor truck down, rather than



Light two-wheeled trailer in which the load is distributed over the trailer axle



Light trailer with wheels interconnected so as to track with rear wheels of hauling vehicle

from the horse wagon up. This has resulted in a vehicle which is similar to the ordinary motor truck in practically all respects, except that it has no engine or propelling mechanism.

As the ordinary four-wheeled trailer carries approximately the same load as the hauling vehicle when used behind the motor truck, its parts are of equal strength to those of the truck. Ordinary truck axles, and wheels carried on some forms of improved roller bearings and steered by motor truck type knuckles, are employed. Certain of the models of this type of trailer are of the reversible type, that is, they may be steered from either end, as desired. When used behind a truck the rear trailer wheels are locked in position so as not to turn, but when the trailer is to be backed into position these can be unlocked for ease in maneuvering into position.

Practically all forms of four-wheeled trailers are now fitted with drawbars equipped with some sort of spring device to absorb the shocks on the tractor mechanism in starting and stopping. The drawbars must also be so designed as to permit the trailer to turn corners easily and to provide for its mounting obstructions in the road or for dropping into hollows or ruts without placing additional strains on the tractor frame.

Most of the four-wheeled trailers used in ordinary commercial service are now equipped with rubber instead of steel tires, because rubber tires permit higher speeds to be maintained. Rubber tires cost considerably more than steel ones and must be replaced more often, but this advantage of the steel tire is somewhat offset, owing to the fact that rubber tires used on trailers are guaranteed for 60 per cent more mileage than those used on ordinary trucks. This is because these tires are subjected to rolling stresses only and do not have to withstand the grinding strains that may be imposed upon the driving tires of a truck.

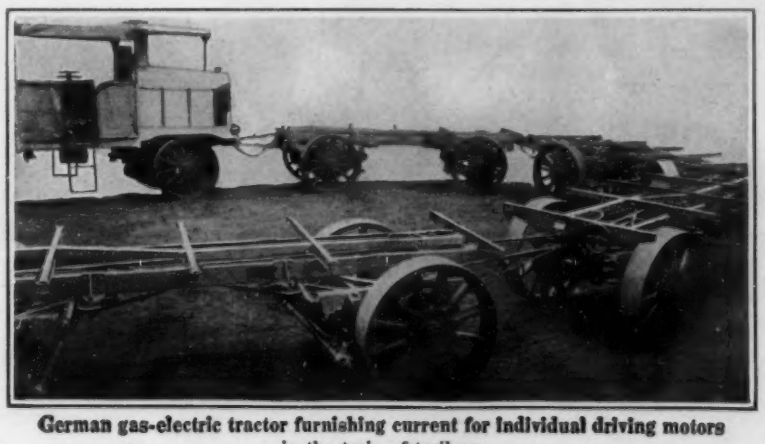
Independent two-wheeled trailers which carry the complete loads balanced over their axles are not used to such a great extent as are the four-wheeled and semi-trailer types. There are many heavy trailers of this type used in trains in the mining districts for hauling ore, their particular qualifications in such instances being the ability to turn around the short corners encountered on the rough roads generally found in the mining districts. Light two-wheeled trailers mounted on pneumatic tires are used for carrying light loads behind small trucks or passenger cars at high rates of speed.

The design of the trailer and of the tractor are dependent upon the work to be done. Some of the tractors used in the mining territory are giant road locomotives with huge power plants generally of the gasoline engine type. Some, however, are of the gas electric type for simplicity of operation. Most of these deliver the full power to the rear wheels of the tractor, while in Germany a gas-electric type in which the electric power is transmitted to all trailer wheels has gained considerable prominence. . In this method type the tractor is equipped with 200 to 300 horse-power gasoline motors, driving a hugh electric generating plant whose power is trans-transmitted to all of the trailers to enable them to propel themselves. This method is quite similar to the multiple-unit system used on our suburban railroad systems. It has the advantage of making it possible to haul loads of 50 tons or more without making the tractor so heavy that it may not be driven over ordinary roads and bridges.

While many of the tractors designed to haul large loads are manufactured as special vehicles, the great majority of those used for transportation purposes in the large industrial areas are conventional motor trucks with minor changes. If they are to be used in connection with semi-trailers, the wheelbases are usually shortened to produce a short-turning vehicle. If used as ordinary trucks part of the time and as tractors hauling a part of a load on other occasions, the wheelbases are kept constant. In either case it is advantageous to increase the final gear ratio between the motor and the rear wheels so as to produce more power at the slower speeds at which such outfits must work as compared to the truck alone.

Radiators of larger cooling capacity are also necessary, especially for continued low-gear work during the hot

(Concluded on page 500)



German gas-electric tractor furnishing current for individual driving motors in the train of trailers

The Motorized Circus—Latest Triumph of Motor Traction

BEFORE the development of our railroad system the circus was perforce what is known as a road show, traveling from place to place over the public highways. For many years, however, all the large shows and many of the small ones have been railroad shows, transporting equipment, performers and workers from place to place by special trains. A return to the principle of the road show is seen in a recently organized American circus, which plans to transport over 4,500 tons of equipment, animals and human freight from thirty-five to fifty miles each night by using one hundred 3½-ton motor trucks and approximately the same number of specially designed trailers.

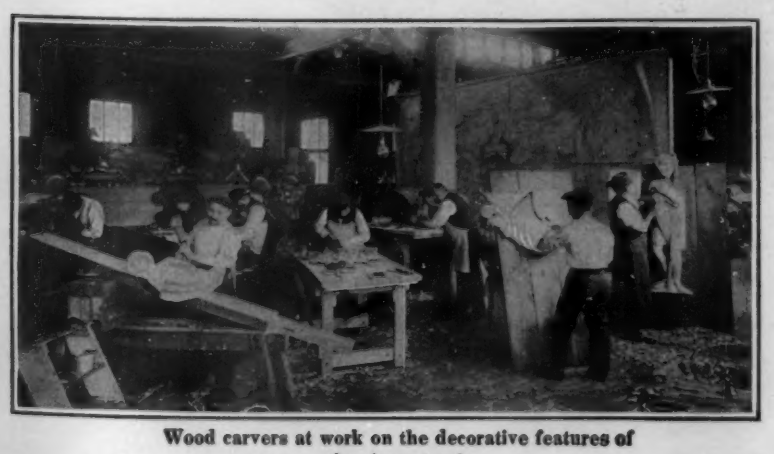
The final decision that this method of moving a circus would prove successful was made only after the master mechanic of the outfit had spent considerable time in studying, on the spot, the operations of the army transport system in Mexico. The motorized caravan will consist of two sections, the parade units and the utility units. The bodies of the former will lose nothing in comparison with the gay and ornate creations which we are accustomed to see in our streets on the morning of circus day. The utility units will include, of course, sleepers for the laboring staff, more elaborate quarters for the performing staff, a few motor giants for the transportation of the big tent-poles and canvasses, a wrecking outfit, tractors, etc. Of course, the parade section will show special trailers for the elephants, giraffe and other architectural oddities among the live stock, as well as all the traditional accessories of the circus parade.

The chief interest of the new project is of course as a motor truck proposition rather than as a circus There has been much discussion as regards the ability of these huge trucks to get over the roads on time. The proprietors, however, have no apprehension on this ground. They even point out that they have great advantages over the rail circus.

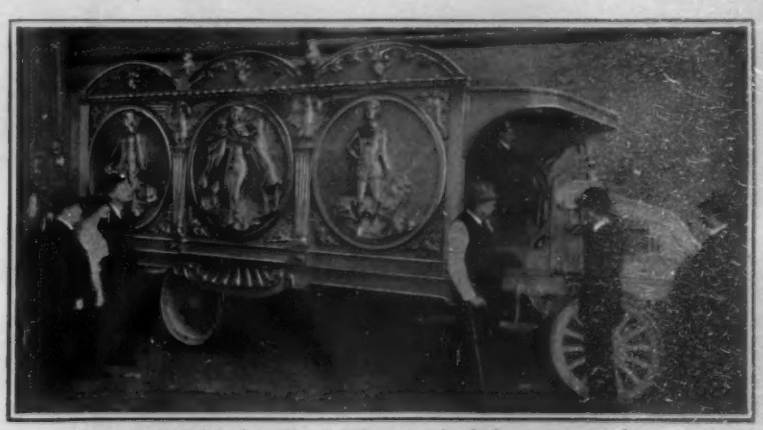
The latter has to move all equipment simultaneously, in one train of one or more sections. Railroad conditions are such that frequently the outfit reaches a town too late to give the usual morning parade, while occasionally the afternoon performance has to be abandoned. The motor circus will avoid this possibility. The equipment will be forwarded to the next stand as soon as it has finished its day's work. Supper served, the cook wagon and auxiliaries will haul up stakes and proceed, while sections bearing the side-shows, menagerie, and other departments will follow it upon the road at intervals. Such of the actual performers as are through early will at once take up their journey, with their appurtenances.

In this way the vanguard of the caravan will be on the new grounds soon after midnight, and under ordinary conditions the entire train will have arrived by eight in the morning. An average speed of ten miles per hour will be aimed at. The country in the East, in which section the circus will start its peregrinations, contains few jumps of more than sixty miles, and many of far less. Hence under average conditions no part of the show will be on the road more than six hours. When the distance is exceptional, the itinerary will be laid out with the view of making the big jump over Sunday. During the first three years of its existence the circus will play the East

(Continued on page 500)



Wood carvers at work on the decorative features of the circus truck



One of the finished bodies for the motorized circus, mounted on standard truck chassis

FEDERAL MOTOR TRUCK COMPANY

MANUFACTURERS OF

FEDERAL
MOTOR TRUCKS

DETROIT MICHIGAN

REPLY TO ATTENTION OF

Mr. M. L. Pulcher

Mr. W. L. Hughson,
Van Ness and Geary Sts.,
San Francisco, California.

Dear Hughson:

Everything comes to him who waits. You've been looking forward to the complete FEDERAL line. Now it's ready - FEDERAL quality in every needed capacity.

We are going to make announcement of all five models in May -- One ton, One and a Half Ton, Two, Three and a Half, and Five Ton models.

The photo prints I enclose will give you a good idea of the jobs themselves, I think they're corkers. How do they look to you?

Remember -- these are not "new" models in the sense of being revolutionary departures from past FEDERALS. All the stamina and reliability of the good old FEDERAL has gone into these trucks -

- in addition, they have everything that motor truck experience has taught us right down to May 1, 1917.

This line of FEDERAL trucks is, in essence, the outgrowth of seven years spent in studying the haulage needs of Business.

It is literally true that we go to Business, study its needs, and build trucks accordingly. We do not depend upon a staff of theoretical engineers looking for new ideas inside the four walls of the drafting room. That's the secret of FEDERAL success.

Features? Every point of FEDERAL construction is a "feature" in the sense that it was designed solely with haulage service in mind.

The engine is a truck engine exclusively -- "full of pep". How important this is can be realized only after the truck has been in actual use for some time.

The buyer also gets four speeds forward and one reverse in all but the One Ton. This means greater flexibility of operation - and lower gasoline consumption.

Another big feature of the FEDERAL family is the FEDERAL system of forced

FEDERAL MOTOR TRUCK COMPANY
DETROIT MICHIGAN U.S.A.

CONTINUING OUR LETTER OF May 1, 1917

SHEET NO. 2

lubrication. Oil is distributed by pump pressure to every point requiring oiling, - the supply being automatically increased as heavy duty or more speed make necessary - and so on.

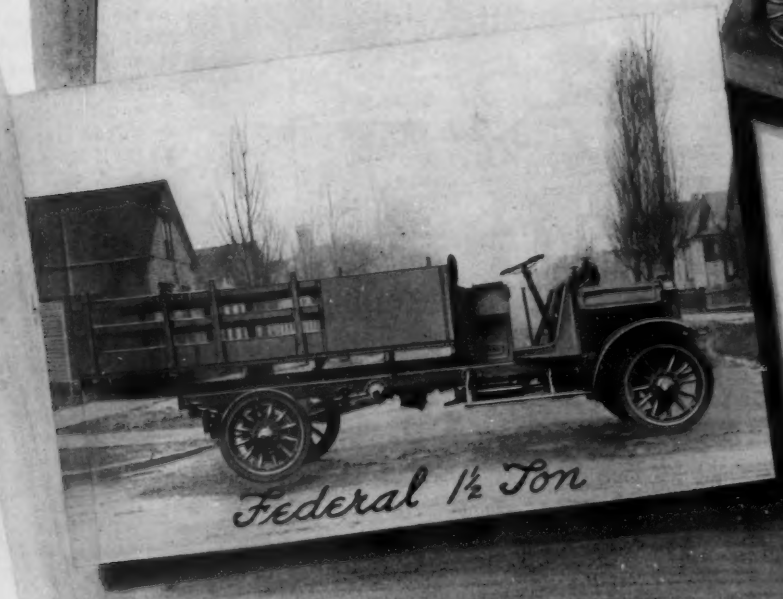
I can't hope to cover all the points here, of course. You have them all in the "Blue Print Book". We are sending quite a number of these in response to mail inquiries. Do not fail to get a supply for distribution direct.

Now then, Bill, here's hoping for the best year yet! I know that this FEDERAL family is going to prove well worthy of its name and that the long list of FEDERAL users to whose complete satisfaction we owe prosperity, present and future will be a steadily growing one.

Yours with best wishes,

M. L. Quelch

Vice President
FEDERAL MOTOR TRUCK COMPANY



The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

The Tractor That Drives Like a Horse

DRIVEN with reins like a horse, the two-wheel tractor manufactured by a Milwaukee corporation is in a class by itself. The simplicity of its operation is indicated by the fact that a pair of reins in the hands of an untrained man, will control it, just as a horse is guided, so that a teamster can undertake to drive the new "army horse." That name was given it in a recent demonstration in Chicago when it was used for recruiting purposes, trailing an artillery caisson, a limber and a three-inch field piece, with full gun crew. The soldier who held the reins manipulated them just as if he were driving a horse, steering by pulling the corresponding rein, stopping by pulling both reins and backing by giving an additional pull. In starting the tractor, he did not say "gid-ap," but he jerked the reins in about the manner used to encourage an animal to proceed.

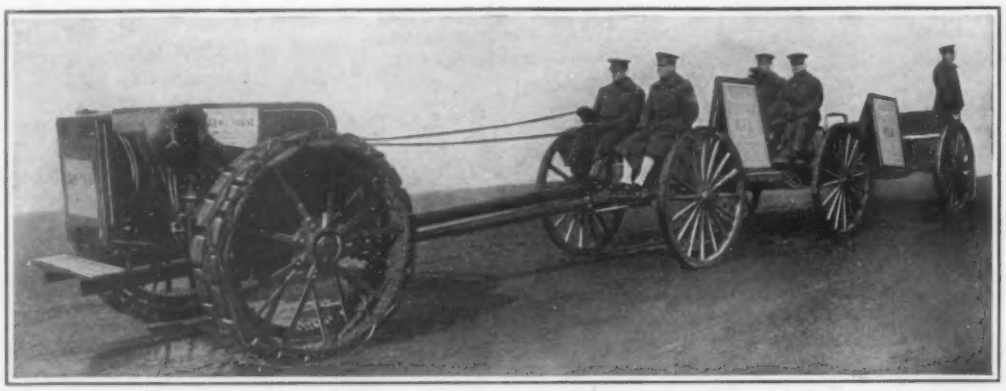
The line-drive tractor was endorsed by military men as "the most efficient motive power for handling artillery and road transportation," and it saw service on the Mexican border.

Aside from its value for military purposes, the novel vehicle is an unsuually economical farm tractor, as one man alone is required to operate the engine and attend to the machine to which it is attached, such as a harvester, disk plow, manure spreader or the like. This advantage is secured by the ease of control and the fact that the driver can ride the load, where he can operate the levers that govern the agricultural implement. An extra man means much in these days of labor shortage, so that a one-man tractor is far more valuable than one that requires two or more to do the work.

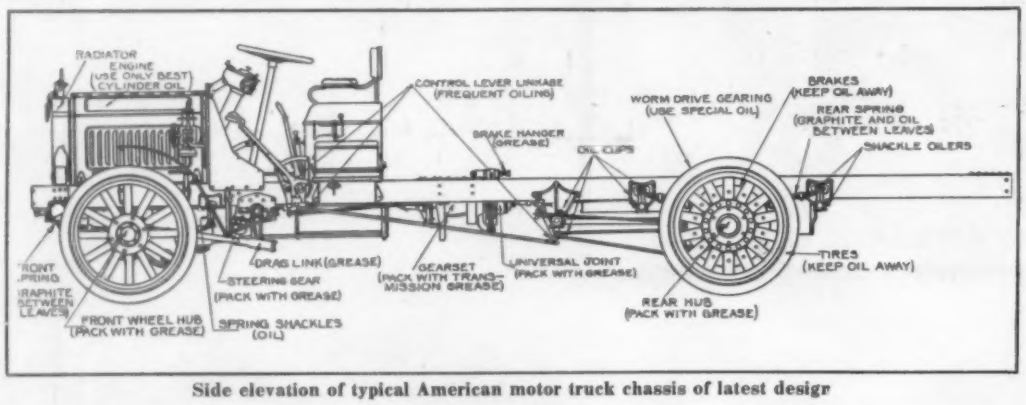
The engine burns gasoline or kerosene and propels the tractor at a speed of from one to 4¼ miles an hour. It has a 15 horse-power pull at drawbar and will handle with ease such heavy work as plowing or hauling heavy trailers and contractors' implements such as road scrapers. The two driving wheels have a diameter of 66 inches and a 12-inch face. The weight of the machine, 5,400 pounds, is all on the driving wheels, making good traction, and the center of gravity is so low that it is practically impossible to over turn it by accident.

As a stationary power plant, the tractor is available for such work as operating a threshing machine, filling a silo or performing similar farm labors, and the lines can be extended to the proper distance so that the man who is in charge of the work can regulate the engine while attending to the other implements.

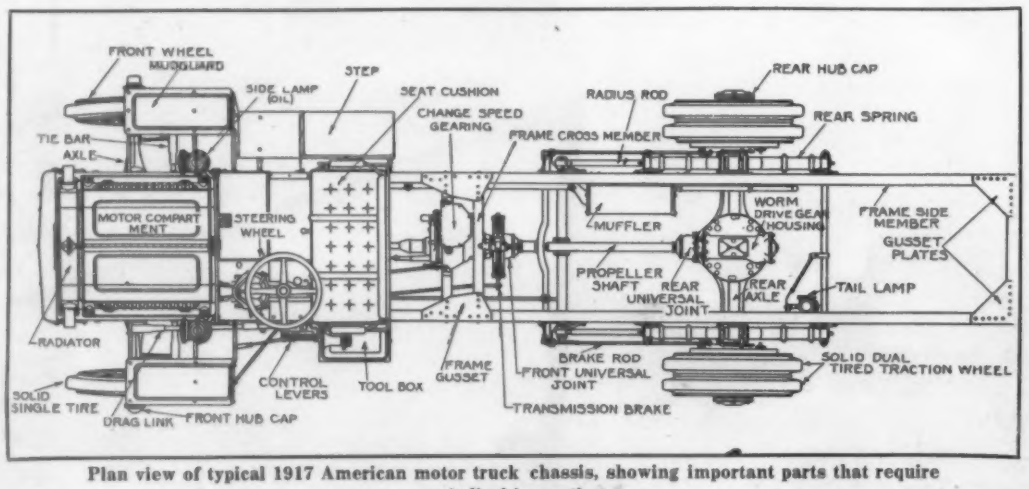
For the contractor, road builder and farmer, this newcomer in the tractor field is designed to do the heavy work of peace, while on the field of war it will doubtless render excellent service in handling artillery and hauling supplies and munitions. The fact that an army teamster can handle it as he would a mule team, without much preliminary training, should be an advantage in putting this line-drive machine to military use. Any device that will reduce the amount of necessary training in these days when there is so much for our men of peace to learn is to be highly commended.



The Army tractor that drives with lines, in the same way as a horse is driven



Side elevation of typical American motor truck chassis of latest design



Plan view of typical 1917 American motor truck chassis, showing important parts that require periodical inspection

The Importance of Systematic Inspection and Maintenance of Motor Trucks

THE motor truck is a complex machine, even in its simplest forms; and considerable delicate apparatus is necessary to make it function properly. Yet there is no form of machinery that is subjected to greater strains and vibration. Road conditions adjacent to docks, freight yards and factories, the regions of the motor truck's greatest activity, are such that with the most careful driving parts will loosen. For this reason, frequent and regular inspection is necessary to successful motor truck operation. Indeed, it is hardly too much to insist that every truck should be looked over at the end of each day's work; and this involves at least superficial cleaning, for it is hard to find loose bolts when the mechanism is covered with dried mud.

It would seem that all this should be taken for granted; yet such is far from the case. The average executive seldom realizes the amount of work necessary to keep the trucks running smoothly. The usual result is that while the trucks stand up well enough through their first year, after they have passed their birthday they begin to pile up depreciation charges very rapidly. The writer has talked with department store managers whose experience led them to assert confidently that the motor truck was exclusively a one-year proposition! In every case this was found, upon investigation, to be the fault of the system.

The methods employed by the leading railroads can be cited as an example of how careful, systematic inspection and maintenance pays large dividends. The steam locomotive is considered by the layman as one of the most reliable pieces of mechanism, and invidious comparisons are made to the disadvantage of the motor truck. If the critics realized the attention a locomotive receives at the end of every run, how carefully it is looked over by experienced wipers and oilers, supplemented by trained mechanics whose one end in life is to detect and correct minute faults, they would perhaps realize that our roads would have no schedules at all if their motive power received no more care than that given so grudgingly to the average motor truck. While the first year cost of maintenance and operation is much higher under this way of doing things, the expense is far more than made up by the longer life of the machine, and the lower maintenance costs in subsequent years, and the improved service obtained.

In order that the non-technical executive responsible for truck maintenance may have some idea of what the manufacturer would consider adequate care, a brief schedule detailing the attention required by the average truck is given. From this, a little study will make it clear that proper truck care can be had only by devoting fixed times at fixed periods to the work of inspection and overhauling.

Lubrication is a matter of the utmost importance, though many truck owners are inclined to let it go by default. Grease cups are placed at various points, not just to suit the manufacturer's fancy, but to be used according to a regular schedule laid down by him. Naturally, some of these are at points not easily reached when the truck body is mounted on the chassis; but the conscientious caretaker will seek them out and keep them properly filled and screwed down. The oiling schedule should be rigidly adhered to, even if it entails personal inconvenience.

Then, too, there are oils and oils, greases and greases. Each is made for some particular purpose, excellent for that purpose, but probably of doubtful value for others. Every manufacturer recommends the grades of lubricant that are best adapted for the various parts of his car. Again he bases these recommendations upon practical experience and his knowledge of his own product; and the truck owner makes a mistake not to use the oils suggested. As a horrible example, I can mention an instance where all kinds of trouble was experienced with heating of the rear axles in a well-known worm drive truck whenever used on heavy work. Investigation showed the trouble to be wholly due to the use of a non-fluid lubricant of so heavy a body that it would not flow between the gears. The user was deliberately disregarding the explicit instructions of the manufacturer, rushing his trucks to ruin as fast as he could, and blaming the manufacturer bitterly for the results.

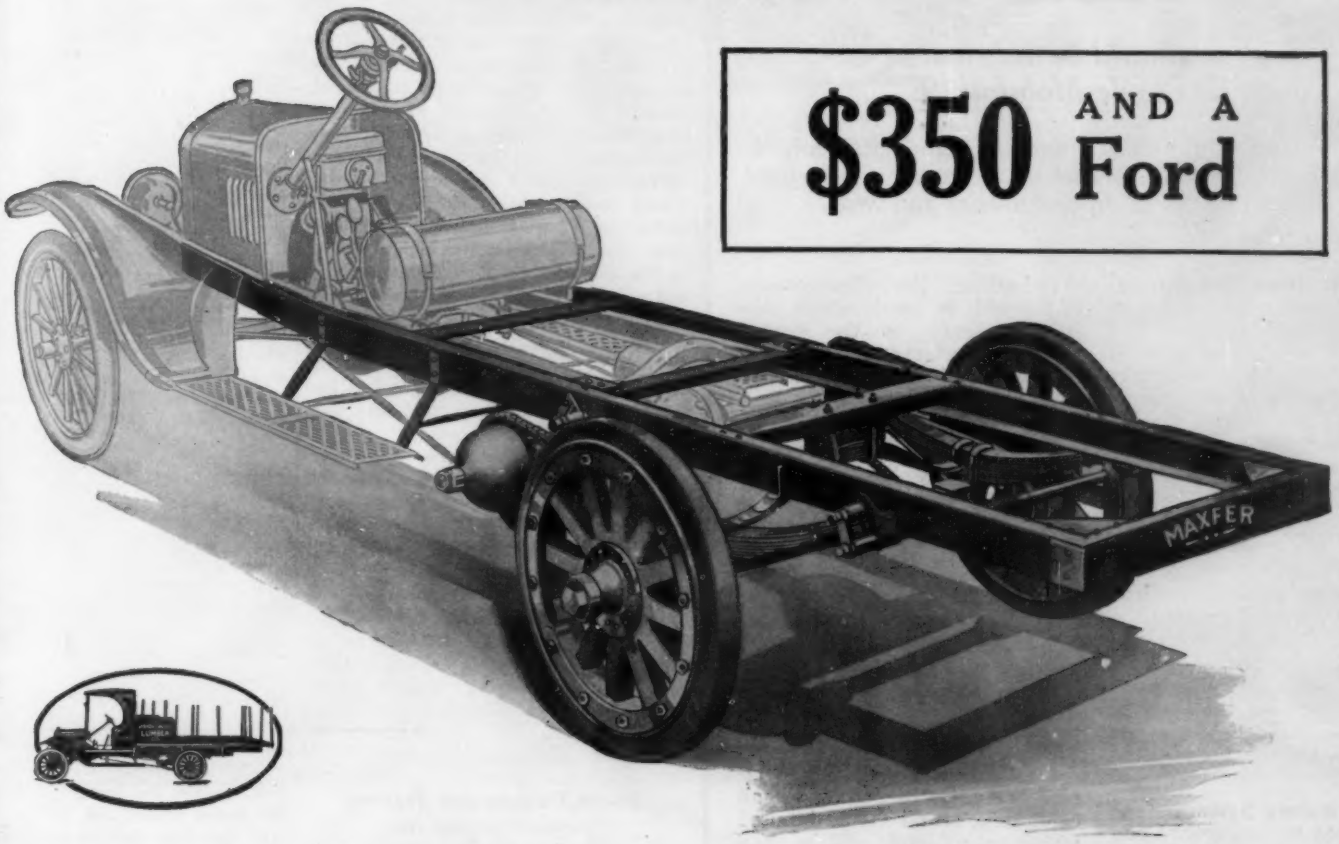
Next to regular lubrication in importance comes regular inspection. If trucks are gone over in accordance with a regular schedule once in two weeks the majority of the lesser troubles will be entirely eliminated and the

(*Concluded on page 510*)

MAXFER

The Realization of the Greatest Truck Value In the World.

$350 AND A Ford

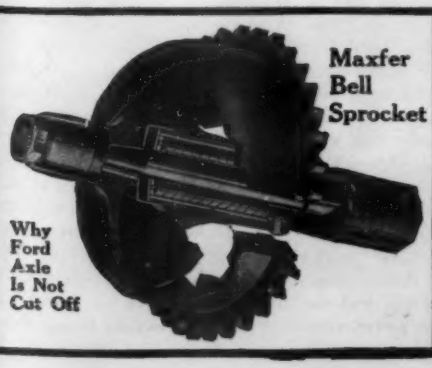


MAXFER means economy. Economy means success. 12,000 merchants, farmers and business men have proven that the *Maxfer* saves them money in their delivery from day to day, week to week, and month to month.

Maxfer makes a Ford, used or new, into a one-ton truck, at $350 and a Ford. The Maxfer does not change the Ford in any way; does not cut off rear axles, does not cut off the frame, and when the Ford is converted into a Maxfer one-ton truck, it makes the most economical truck for hauling and delivery ever produced. Our records show that a single Maxfer truck saves money in comparison with the cost of one-horse or two-horse delivery.

The Maxfer has been tested and tried by the largest merchants and business men who have the delivery problem to solve and in every instance it has shown the way to lower costs. Can you afford to use horse delivery when the Maxfer trucks will deliver your merchandise to your customers every day at less money than it is costing you at the present time?

Maxfer has in the United States over 1200 dealers, located in all the principal cities and many of the smaller towns. We will be glad to send you the data showing how you can Economize, Standardize and Maxferize your delivery.



MAXFER
THE WHALE FOR WORK
TON TRUCK

Maxfer Truck & Tractor Co.
910 So. Michigan Ave.
Chicago, Illinois

COUPON

Maxfer Truck & Tractor Co., *SA-5-17*
910 So. Michigan Ave., Chicago, Ill.

Please mail to me full particulars of the Maxfer Truck.

Name .....

Street .....

City ..... *State* .....

Coöperation Between Business Men and the Schools

(Concluded from page 488)

in the long run it is an economy to organize their business for the use of high-class workers, rather than for the employment of low-grade labor. The task of inducing such a man to give the Cincinnati plan a trial is no light one.

The employer, however, who will actually cut off his nose to spite his face is comparatively rare; and many of those who went into this experiment reluctantly and skeptically, are now among its most enthusiastic advocates. They have found that under this form of coöperation they have a better selection of young workers to begin with. They find that there is less "turn-over" in the flow of labor. They find that these students, although they are away from the work every other week, advance in their efficiency more rapidly than the ordinary run of workers. They find that they are able to discover special abilities or talents on the part of the worker more readily than they do ordinarily; and the school helps them train these special abilities for higher service in the corporation. One employer, who had objected to the plan of training two apprentices in one position, on the ground that beginners were not worth their pay for four or five months, volunteered the information before the students had had three weeks of work each, that they were already earning their wages.

There are many obstacles to be overcome—chiefly in the way of inertia and prejudice. But the experiment has gone far enough to show that the plan of cooperation between the employers and the schools is bound to raise the standards of workmanship, to improve the conditions of work, and to standardize the work and pay of young workers. All of these factors make for higher general efficiency of living as well as of producing, and the scheme initiated by Dean Herman Schneider will have far-reaching effects in all parts of the country for many years to come.

Motor Tractors and Trailers

(Concluded from page 495)

summer months when the ordinary radiator is not sufficient to prevent the engine from overheating unless the radiator is of more than the average size in the first place. It is also necessary to strengthen that portion of the truck frame which was not designed to take any of the stresses imposed by the trailing vehicle. Users have also found it advantageous to increase the size of the truck brakes unless the trailers are equipped with some form of mechanical brake to aid it when maneuvering over hilly country. One size larger tires have also been fitted on the rear truck wheels by many owners and have given very satisfactory results.

Another development of the conventional motor truck for use with trailers has been the fitting of a gear set with four instead of three speeds. This of course gives an added speed change which often times makes for easier running over difficult roads.

In general the standard truck of today is equipped with an engine of sufficient power to pull, over fairly good roads, considerably more of a load than it can carry, and its driving mechanism to the rear wheels is sufficient to handle the entire power output of the engine. Under these conditions the use of trailers consists simply of making use of the truck's latent pulling ability.

In general, tests have shown that the ordinary motor truck carrying its capacity load can pull in addition another load of equal tonnage. These conditions hold true when the roads are fairly level and when the trailer is properly constructed and fitted with truck type wheels, carried on improved types of bearings. Of course, as trucks are used over poor roads with many grades, their hauling capacity is correspondingly decreased.

One important consideration which is not generally known, even among present-day users of tractors and trailers, is the method of distributing the load. Most trucks of today are overpowered and use but a small percentage of that power when traveling over well-paved streets or roads with grades under three per cent. The overplus of power is provided to enable the trucks to negotiate steep grades with full loads or to pull through sandy country, where, of course, the demands made upon the motor are greater than those under ordinary conditions.

The use of a trailer behind an ordinary motor truck at once begins to make use of some of the surplus power of the motor. For this reason it is advantageous to place less than the capacity load on the truck and more on the trailer when the outfit has to negotiate grades or sandy roads. The reason for this is that if a truck is carrying its capacity load it immediately begins to draw upon its surplus power as soon as it strikes the grades and often most of this is required to enable the truck itself to ascend. If, however, less than the capacity load is placed upon the truck, it still retains some of the surplus power to pull the trailer and its load over the grade. In other words, better results can be obtained by loading four tons on a five-ton truck used in connection with a five-ton trailer and six tons on the trailer, than would be the case if the load were distributed evenly on the two vehicles.

The development of the trailer in the future is undoubtedly toward the four-wheeled trailer mounted on rubber tires, especially in the industrial centers. The reason for this is that the four-wheeled trailer permits the load to be distributed over two axles instead of one as is the case with the wagon-like semi-trailer of heavy capacity. While there is undoubtedly a large future for the light two-wheeled semi-trailer as used behind passenger cars and small trucks, the heavy type with steel tires will undoubtedly be restricted due to the damage done to the roads. Loads of 10-tons, carried on one axle with steel tired wheels, exert a tremendous impact when passing over inequalities in the road surface and this impact has resulted in breaking up the foundation of roads with not more than six-inch concrete beds.

Notwithstanding the adverse legislation against the heavy semi-trailer type, the motor trailer and tractor are here to stay and their development will be rapid owing to the acceptance of the trailer principle by transportation interests generally. The acknowledgment of this principle has now spread throughout the country and thousands of truck owners are reaping the benefits accruing from trailer economy. Aside from the mechanical development of trailers which are lighter than those now manufactured and yet can carry the same loads, the one great feature to be invented is the adoption of some form of automatic trailer brakes applied in conjunction with those on the tractor without additional effort on the part of the driver. These brakes are especially needed when trains of more than one or two trailers are employed. Safety in descending steep grades and in making quick stops on level roads demands an automatic brake.

The Motorized Circus—Latest Triumph of Motor Traction

(Continued from page 495)

and Middle West, where good roads make travel possible under all weather conditions likely to be met during the circus season.

Some interesting facts are gleaned to show the thoroughness with which the engineering features of the undertaking have been worked out. A new type of tractor is to make its debut with the circus—a combination of familiar agricultural and commercial types, capable of extracting the heaviest car from the deepest mudhole. A motorized stake driver has been developed which, operated by a man and a boy, drives 350 stakes per hour and does the work of a crew of 30 men, requiring no manual work except the insertion of the stakes in the machine. A stake puller with crane attachment goes with it, so that no matter now fast a stake be driven, it can always be yanked out expeditiously. One of the biggest jobs in the circus is handling the main canvas. In this circus reels mounted on special trailers will reduce this task to its lowest terms. And

(Concluded on page 502)

The Motorized Circus—Latest Triumph of Motor Traction

(Concluded from page 500)

so on down to the smallest item that can conceivably be transferred from the domain of the circus husky of evil reputation to that of the motor.

An important precaution will be to ascertain in advance the state of the roads. Advance men will act as scouts and report to headquarters. The first scout car forming part of the advance advertising section, will start 40 days ahead of the circus, and its crew will make definite arrangements for the lots, permits, etc., in the different towns of the route. A vital part of their job is to see to it that the route laid down has plenty of switches, like the German trench line, to which the show can be transferred at a moment's notice if conditions developing later should make this advisable.

The main advertising squad travels a month ahead of the show. It consists of a dozen men, with three trucks and a passenger car. Twenty and fourteen days before the circus is due, bill-posting crews will appear on the scene and see that all roads within a radius of 50 miles of the circus lot are properly plastered. At the same time a complete report of road conditions will go to the management. Not relying entirely upon this, it is planned to keep four road scouts on motorcycles four days ahead of the caravan as a final check, and they will indicate any work that may be necessary to render the roads fit for the passage of the show.

While no serious difficulty is expected in the East, it is anticipated that in some cases it may be necessary to undertake repair work or actual reconstruction to make the roads safely passable for the heavy caravan. So the management has arranged to send a road engineering corps a day or two ahead of the circus itself. Twenty skilled construction men and two foremen will be provided with four trucks, a crane and a special traction engine. Every modern device for rapid road repair, including braces and timbers for strengthening weak bridges, standard parts for building culverts, even sectional pontoon bridges for crossing small streams, will be included. With all this inspection and preparation, it seems certain that the show itself will go through any reasonable road area without serious trouble.

Next in importance to suitable highways comes the maintenance of the trucks in good mechanical condition. For this end a complete wrecking outfit will be carried, a machine shop truck similar to those used by the Army in Mexico, and, of course, the most competent crew of mechanics that can be found.

On the road the train will proceed with almost military precision. It will be divided into divisions of ten trucks, with trailers; and in charge of each division there will be a superintendent, mounted on a motorcycle. As the trucks are all of the same make, and as they will be provided with governors to keep the speed about ten miles per hour, there should be little difficulty in maintaining the proper convoy formation.

The progress of this unique circus will be watched with the greatest interest, not only by highway associations and motor clubs, but by the hardheaded business men of the regions traversed. For it seems wholly on the cards that the experience gained will make possible the organization on a commercial basis, of motor truck trains which would go far toward solving the problem of the short overland haul, and thus make a big contribution to the elimination of one factor in the high living cost.

Natural Gas to Blow a Fire Whistle

THE city of Ashland, Oregon is indebted for a saving of several hundred dollars, to the inventive brain of a mechanic of that city, who conceived a unique idea of operating the mechanism of a six-inch fire whistle, by soda water gas. A two-inch pipe connects with a gas well near the city, and the gas is pumped into Ashland under heavy pressure, which causes the whistle to be heard for several miles.

Motor Traction in Modern War

(Continued from page 487)

trucks of one and one-half tons capacity; six motor truck companies containing 28 trucks of three tons capacity, and two companies each consisting of 33 trucks of three tons capacity had been purchased and were in operation along the Mexican border. Over $2,000,000 had been expended in motor trucks, auxiliary equipment and repairs at the time the report was written. Since that time the number of motor trucks in use has increased.

The approximate cost of operation of trucks per ton-mile in the Southern Department was given as $0.70, which figure includes all incidentals such as repair shop upkeep, etc. There are about 2,600 motor trucks of various types now in use in the army, and it is said that this number was adequate for the requirements of the regular establishment as organized prior to the declaration of a state of war with Germany early last month. The number of trucks purchased by the Quartermaster Department of the Army in the fiscal year covered by the report, totals 573 transport trucks, 12 machine shop trucks, 6 wrecking or repair trucks and 58 tank trucks. Trailers were used, but they did not prove entirely satisfactory, owing to exceedingly bad road conditions. Ordinary common sense should have told the officials that before the expenditure for their purchase was made. The report says that trailers will be useful on all long lines of communications. This undoubtedly means where some resemblance of roads exists. Seventy-five motor cars of the pleasure car type were purchased for officers and also 61 motorcycles and 8 tractors. Besides the transport trucks purchased, the Department also procured five "track-laying" tractors, two towing winch tractors, one agricultural tractor, three road rollers, and 18 bottom dump trailers with other articles of road building equipment. The remainder of the trucks now in use were purchased after the report was made.

One of the first lessons learned by the European belligerents was that successful and economical motor truck transportation could be reasonably expected only when they were operated over roads. As soon as Italy had entered the war an army of nearly 25,000 men was put to building roads and has been kept at that work ever since. The road building is carried on over there just as systematically as the motor ambulance service or the transportation of munitions. On the western front, France had similar experiences.

It is entirely possible to build motor vehicles that can be operated under almost any conditions that would be met with, but special types would have to be developed that would be much more costly and considerably lower in efficiency than the standard forms, and that would be difficult to obtain promptly. The American Army Engineers must learn how to build satisfactory roads and the truck trains must be operated by capable driving personnel, and run on regular schedule and not in the haphazard ways that critics claim were used on the Mexican border. The French experience has been that trucks of three and one-half tons capacity are the ideal for army transportation work, and our own Army owns a large number of four-wheel drive two and three-ton trucks which proved to be satisfactory even in the roadless areas of Mexico.

Automobile engineers who have had the opportunity of studying the practical operation of trucks on the border criticise the tendencies to overload the army truck, and also state that their work was not laid out so that the trucks could be used with the greatest efficiency. Cricitism has also been made of the provisions for repairs, as even the most intelligent users of trucks cannot prevent a certain amount of depreciation. The repair service needed can be divided in three general classes. First aid is given by mobile, wrecking and machine shop trucks which should accompany each train and which are able to handle emergency repairs. In Europe, one repair shop truck accompanies each convoy of 44 trucks which is a third

(Concluded on page 504)

Mechanical Aids In Loading and Unloading Trucks

(Concluded from page 491)

employ a body of this nature having twelve different compartments or sections, each one separable from the remainder.

Incongruous as it may seem, the most efficient example of the supplementary crate system is to be found in the street cleaning department of several of our American cities, where it is used effectively for the quick removal and disposal of garbage. Specially designed trucks have been built, having accommodations for eight or ten movable sections in the form of buckets. These buckets may be filled with refuse by the street cleaners at various sections and then picked up and set in place as the truck moves down the street, rapidly collecting its load of units which constitute its body; arriving at the disposal station the sections or buckets may be lifted by means of an overhead traveling crane and carried to the proper portion of the plant, as determined by the nature of their contents.

The above are only a few of the large number of methods employed daily "to keep a truck busy all the time." Each truck installation will require a variation in loading and unloading facilities. Each of the methods outlined, however, is subject to rearrangement and can be supplemented by certain features from the others, so that almost any condition of motor haul loading and unloading may be met. Because of this very variety of requirements, truck manufacturers, for the most part, sell the chassis alone and equip it with a special body provided with any form of loading and unloading attachment which may be designated.

A Keyboard Machine for Sorting Letters

(Concluded from page 491)

the triggers on any carrier so that they will be tripped at a given compartment, and at that compartment only.

This indicates clearly the general *modus operandi* of the machine. Just as every key of a typewriter is connected alike with the space bar and with its own particular type bar, so that each stroke performs the general operation of spacing and the specialized one of printing, so in this machine each key is connected with the general mechanism for sliding the letter over into the carrier which happens to be standing opposite the board, and also with its own particular apparatus for setting the triggers upon that carrier to the particular combination that pertains to that key and to its corresponding compartment. The slots by means of which the letters are held in the carriers are well shown by our second cut.

Once inserted in its carrier and the triggers on the latter properly set, the letter proceeds by jerks as each subsequent key is struck. It passes without recognition all the wrong compartments; but as it reaches the right one, for which the triggers holding it in place are set, it is released by the tripping of those triggers, and falls out and down into the compartment.

In the machine shown, each carrier has four triggers, each capable of assuming four different positions, making possible sixty-four different combinations, and hence as many different sortings. Plainly, however, the principle is susceptible of infinite extension, both by increasing the number of triggers and the number of positions which each can take. The same mechanism on the compartment's edge that trips the triggers restores them, after the letter has been dropped out, to the normal position in which they must be found by the setting apparatus as they pass the keyboard on their next round. This particular machine is 28 feet long. Of course the power for operating it is furnished by electric current; the pressing of the key in each case simply closes the circuit, as in the electric adding-machine or typewriter. While so far only used on letter mail, it is planned eventually to construct machines for use in sorting newspapers and parcels.

Motor Trucks in Modern War

(*Concluded from page 502*)

greater than our largest motor truck company. Intermediate repair stations are established some distance back of the line where more serious repairs are made and a complete stock of parts is carried.

The War Department committee which has been engaged in revising the motor truck specifications with the assistance of the S. A. E. has completed its work for the year. In general, the specifications are the same as those issued about a year ago and outlined in these columns. The specifications are broader and go into more detail regarding materials used and equipment. The principal features of the new trucks are a poppet valve power plant of the four-cylinder type, having a piston displacement of about 312 cubic inches for the one and one-half ton truck and 414 cubic inches for the three-ton chassis, and pressure lubrication. A disk clutch and four speed selective sliding gear transmission with a low gear ratio of at least forty to one is stipulated. Worm gear final drive is recommended. A minimum road clearance of 14 inches is desired and some form of locking differential must be provided. Electrical lighting equipment, which was not looked upon with favor in former recommendations is now desirable. The radiator must be of about twice the capacity of those fitted on similar trucks used for commercial purposes. Steel wheels are preferred to wood spoked forms which are liable to shrink in hot, dry climates and which are more easily damaged by shell fire. The tires should be 36-inch by 4-inch solid, demountable. Interchangeability of radiators, fuel tanks and body attaching devices is desirable, as is the use of standard magnetos and carburetors. Special materials are specified for all important parts, especially the springs and power transmission members. Strong bumpers should be provided to protect the radiator against damage. Other minor requirements such as the provision of towing hooks and sprags, reserve fuel tanks and brakes of ample capacity are not difficult to meet and call for no radical changes in many existing designs.

Special purpose vehicles are being experimented with, but so far no specifications have been definitely determined for armored cars, artillery tractors or road trains. Despite the chaotic conditions that now obtain, the close coöperation extended by the engineering societies to the army authorities will reduce much of the confusion that now exists, to order and system, and the country will be fortunate, indeed, if all its army needs can be worked out as quickly as the transportation problem will be.

The Chemistry of Bitumen

A GOOD example of the way chemical research goes on and on, and on, was brought out at the Kansas City meeting of the American Chemical Society by Messrs. Charles H. Reeve and Richard H. Lewis, chemists to the United States Office of Public Roads and Rural Engineering, in their paper on "The Effect of Exposure of Some Fluid Bitumens." It is a continuation of work first presented in a paper read at the Eighth International Congress of Applied Chemistry in New York in 1912, and published in the American Chemical Society's *Journal of Industrial and Engineering Chemistry* in 1913. It was by Hubbard and Reeve. The second report was presented in that society's journal in 1915. The present is the third instalment, by Reeve and Lewis.

They announced work among fluid types of products which had not been previuosly investigated. The relation between the amounts volatilized by heating in a laboratory oven at 163 deg. C. (or 325 deg. F.) and that lost by atmospheric exposure was shown by tables. The residues left by both methods were described. The changes observed as the result of long exposure were found to be greater than can be accounted for by the loss of volatile constituents and are due to chemical changes which take place in the chemical structure of the bitumen.

What a Soldier Eats

(*Concluded from page 487*)

soldier nephew was provided with 18 ounces of bread, and half an ounce of butter to spread it with; or, if he preferred, he could supplement this with 1.28 ounce of jam out of the larger of the mysterious jars, instead of eating that jam "straight." After the bread, he could make the backbone of his three meals out of 20 ounces of potatoes, 12 of bacon and 24 of beans. He was entitled to use .64 ounce of lard in cooking these—or getting them cooked—and when he came to putting them down he had .64 ounce of salt, .04 ounce of pepper and .16 gill of vinegar to smooth the way for them. Finally, if he wanted to wash them down with anything besides water, he might use for that purpose 1.12 ounces of coffee, with 3.2 ounces of sugar and 5 ounces of evaporated milk to improve the flavor. If he was still unsatisfied after all this, however, he would have to prey upon a sick comrade or go to bed hungry; for according to Uncle Sam he would have had all he needed to eat.

On a basis of total calories, the United States regular is almost the best fed soldier in the world; for with 4,199 calories per day he ranks second only to the Russian private, who gets 4,929 calories. If fighting ability is in direct ratio with food consumed, the moujik should be a worthy foe for anybody; and in fact he is—it is bad equipment and bad officering that have kept him from playing a more decisive rôle in the war.

French, British and German rations are almost on a par; the poilu gets 3,340 calories, Tommy Atkins 3,292, and the minions of ruthlessness 3,147. We should really expect that the German soldier would get a trifle less to eat than his contemporaries—not that he would be deliberately stinted, but merely that his thorough-going and methodical superiors could be trusted to work out a scientific minimum for him.

At the bottom of the scale, both in eating capacity as estimated by his own government and in fighting ability as seen by his allies as well as his enemies, comes the Austrian soldier. If our confidence in the ability of the Kaiser's staff to say on just how little food a man can fight be not misplaced, it would seem that our present graphical display might well account for the Austrian soldier's traditional ineffectiveness.

Accessories That Make the Fighting Aeroplane More Efficient

AT the beginning of the war the Lewis machine gun had already been tried out, and today it is being used, in an improved form, almost exclusively by the British army and naval service. The Vickers gun is used to some extent by the naval air service with very marked success, although it is a heavier gun. Having secured the right from the French government to use their machine-gun sight, the British have succeeded in making accurate shots of the ordinary pilot and observer.

When war broke out the British soon found themselves short of German lenses for photographic purposes; but, thanks to the aid of French and American lens makers, they have aerial cameras today which are equal to those of the Germans, and can take an accurate photograph at a height of 8,000 to 10,000 feet—far above the trajectory of the artillery fire.

The camera is invaluable in this war: it gives an accurate record of all the development behind the enemy's lines. When an army of 100,000 men is being moved up, there must be trainloads of food, clothing and ammunition moved up too. So it remains for the aerial photographer to secure photographs of the railroad sidings, the enemy trenches and other enemy activities, and it is this photographic data which permits the general staff to know definitely how many yards of trenches have been added since the day before, how many new divisions have been brought up on a given front, and so on. Sometimes photographic reconnaissance patrols are sent out four times a day, and within an

(*Concluded on page 510*)

FOREIGN COMMERCIAL NOTES AND QUERIES

Manufacturers who are interested in the trade opportunities listed in this column, can obtain the names and addresses by complying with the following simple rules: 1. Write only one inquiry on a sheet. 2. Always give the serial number. 3. Write on your own business letterhead. The publisher of the SCIENTIFIC AMERICAN assumes no responsibility as to the financial standing of concerns or individuals. Address all communications to the Query Editor of the SCIENTIFIC AMERICAN, Woolworth Building, New York.

522.—A firm in Italy wishes to secure an agency for the sale of asbestos and asbestos goods, paints and varnishes, malleable iron joints, and industrial and agricultural machinery. Quotations should be made c. i. f. destination. References. Correspondence should be in Italian or French.

523.—An importer in Spain is in the market for machinery, pumps and tools of all kinds, such as screw plates, drills of all kinds, smoothing planes, measuring tools, T squares, augers and bits, and braces; stopcocks for gas and water piping, chain hoists, jacks, bolts and nuts, soldering lamps, machines for cutting and making holes in iron plates, anvils, hammers, screw drivers of all kinds, metal saws, large metal cutting and stamping machines, etc. Quotations should be made c. i. f. destination or f. o. b. New York. Payment will be made by cash against documents. Correspondence should be in Spanish. References.

524.—A company in South Africa desires to secure an exclusive agency for the sale of portable marine motors for rowboats. Quotations should be made f. o. b. New York. Payment will be made by cash against documents in New York. The motors should be packed in strong cases. Correspondence may be in English. Reference.

525.—The government of a republic in Central America desires to purchase a complete plant for making rifles, revolvers and light artillery ammunition on a small scale; small plants for waterworks and electric lighting for towns of from 5,000 to 10,000 population; second-hand machinery for small foundry and machine shop; and wood-working machines for a small furniture factory and planing mill; spiral-riveted sheet-iron pipe; and galvanized pipe and fittings. Quotations should be made f. o. b. American port. Cash will be paid. Correspondence should be in Spanish.

526.—A man in Bolivia desires to receive quotations on a cylinder printing press, drum type, capable of taking 24 by 38-inch paper at the rate of 1,200 to 1,500 per hour. Correspondence should be in Spanish. References.

527.—Officials of a foreign government wish to receive catalogues and full information from American manufacturers and exporters of machinery and tools for making porcelains. Catalogues are also desired by the American consular officer.

528.—A commission merchant in Spain would like to purchase motorcycles, or secure an agency for the sale of same. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

529.—A firm in Brazil wishes to secure an agency for the sale of motorcycles. Quotations should be made f. o. b. American port. Payment will be made by cash against documents at port of shipment. Correspondence may be in English. Reference.

530.—A commission merchant in Spain would like to purchase photographic material or secure an agency for the sale of same. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

531.—A commission merchant in Spain desires to purchase typewriters or secure an agency for the sale of same. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

532.—A man in a British insular possession wishes to be placed in communication with American manufacturers and exporters of machinery for making cement out of lime and rubble, with a capacity of 25 to 30 tons per day. Estimates for complete installation should be submitted. Quotations should be made f. o. b. New York. Correspondence should be in French.

533.—A firm in Spain is in the market for clocks, without pendulums, for railway cars. Cash will be paid. Correspondence should be in Spanish. References.

534.—A man in South Africa desires to secure an agency, on a commission basis, for the sale of hardware, brassware, electric-light fixtures, paper, agricultural machinery and other goods for South African markets Samples should be submitted. Quotations should be made f. o. b. New York or c. i. f. Cape Town or Durban. Correspondence may be in English. References.

535.—A merchant in Spain wishes to secure an agency for the sale of agricultural machinery. Correspondence should be in French or Spanish. References.

536.—A commission merchant in Spain is desirous of purchasing mechanical toys, or securing an agency for the sale of same. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

537.—A firm in Spain desires to purchase two complete plants for the manufacture of chicory, consisting of dryer, roaster, mill, grader and all accessories, one plant to have a capacity of 6,614 pounds and the other from 2,204 to 3,307 pounds per day of 10 hours, for delivery in August, 1917. Blue prints and full information should be submitted. Correspondence may be in English, but Spanish is preferred.

538.—A man in Switzerland is in the market for artificial leather, 25 to 35 yards long and 60 inches wide, for upholstering furniture and automobiles. Quotations should be made f. o. b. New York. Payment will be made upon receipt of documents. Samples and prices should be submitted. Correspondence should be in French or German. Reference.

539.—A commission merchant in Spain desires to secure an agency for the sale of aniline colors and chemical products. If possible, quotations should be made c. i. f. destination, otherwise, f. o. b. New York. Payment will be made against shipping documents through a local bank. Correspondence may be in English. References.

540.—The superintendent of an industrial institution in India is in the market for hand-knitting machines and bookbinding materials. Quotations should be made c. i. f. Madras. Payment will be made through local bank on arrival of goods. Correspondence may be in English.

541.—A man in Spain desires to represent American manufacturers and exporters of automobiles, selling for about $1,000 and $1,800. Quotations should be made c. i. f. Cadiz f. o. b. New York. Separate quotations are desired for chassis. He is also interested in tires, lubricating oils, greases, and other accessories. Payment will be made by cash against documents at destination. Correspondence should be in Spanish. References.

542.—The street cleaning department of a city in England desires to purchase 60 horse-power vacuum motor road sweepers, with a speed of 12 miles per hour, driving brush 7 feet 6 inches long and 4 feet in diameter, and with a velocity of 300 revolutions per minute. Cash will be paid on delivery.

543.—An Argentine business man, who is now in the United States, wishes to secure agencies for the sale of hardware, tools and materials for making tents and sails. References.

Testing Leather for the U. S. Government

(*Concluded from page 493*)

This, however, is only a test of *the ability of the leather to resist the scraping action of the abrasive wheel.* It is in no sense a duplication of the actual process of leather wear on the bottom of a shoe. It is at least conceivable that one leather which resisted abrasion less than another, might wear the better of the two if made into a shoe. Extremely hard and unpliable leather might resist abrasion well, but yield readily to footwear, which includes a bending action.

Owing to the great demand for leather many possible sources of supply are being sought. The Bureau of Standards in conjunction with the Bureau of Fisheries is now investigating the possibility of utilizing shark skins and other fish skins for making leather.

To test leather under conditions which simulate those found in walking, a machine has been invented and developed at the Bureau of Standards known as the "sole-leather testing machine." It might well be called a leather walking machine, inasmuch as it actually walks samples of leather over a cement mortar surface much as a man's foot walks the leather sole of his shoe over a cement pavement.

The apparatus consists of a cam of clover-leaf shape about eleven inches in diameter, which carries four test pieces, one on each of its four faces. This cam revolves on a horizontal axis about thirty times per minute—the axis having bearings at the middle of two parallel metal bars pivoted at one end, and free at the other end. The cam, carrying the weight of the bars (and any additional weight that may be suspended from their free end), rests on a horizontal disk, 15 inches diameter, the point of contact being 5½ inches from the axis of the disk. This disk has a top surface of cement mortar, and rotates about a vertical axis on which is a "brake wheel" provided with a brake strap, by means of which any desired resistance to rotation may be secured by applying dead weights. The cam is driven by a chain, and in turn drives the horizontal disk with which the test pieces are in contact.

The apparatus is designed with a view to subjecting the test pieces to (1) a moderate impact against the wearing surface of the disk as the the cam revolves, (2) a driving (shearing) action under pressure (while bent as in a shoe) and (3) a slight abrasive action resulting from a slight twisting effect at the place of contact between the cam and disk. The amount of pressure and shear may be adjusted as desired and the test may be made with the leather either dry or wet.

The machine differs entirely from a plain abrasive machine. The leather is not subjected merely to frictional action *by* a revolving wheel, but instead the leather under test itself drives the wearing disk. This can be readily seen in the illustration. The four samples of leather mounted upon the clover-leaf cam push around the horizontal wheel of cement mortar to the progress of which a resistance is interposed in the form of a brake with a floating hanging weight beneath.

Forty thousand revolutions of the clover-leaf cam are approximately equivalent to a 20-mile walk by the wearer of the mythical shoe represented by the leather sample. Samples are weighed before and after test. The loss in volume indicates the amount of wear. This is computed to correct for the varying densities of different kinds of leather. The test thus gives an index to the ability of the leather to resist wear. The average sample, 20 centimeters long and 5 centimeters wide, weighs about 70 grams. The loss in a 22-hour test of 40,000 revolutions or steps will run from 5 to 25 grams. In some cases where very poor leather has been tested the sample actually wears out before the test is completed.

The accuracy of the machine is now being tested against such facts as are known by the leather trade. Samples of leather of known wearing quality are tested to find if the machine gives results similar to those obtained by the actual wear of leather in shoes. The 120 tests already made by the Bureau indicate that this is the case.

It is well known that out of any one hide, the leather which comes from the back of the animal over the kidneys is of greater wearing durability than that from the under or belly side of the hide. Samples of leather from the same hide, one from the best, one from the poorest wearing parts, show only the expected results upon the leather "walking" machine and in almost all the tests similar results have been had.

With the accuracy of the tests made by this machine established, it was exhibited to a number of leather experts. They were all much interested and pleased with the action of the machine, because of the care taken to insure the similarity to wearing conditions—the bending of the leather, the impact, the shearing friction, such as comes from raising and turning the foot at the same time.

Because of the difficulty of reproducing a cement mortar surface with the exact degree of hardness and grittiness one sample may possess, it is planned to have a standard carborundum disk replace the concrete "pavement" of the machine. Inasmuch as carborundum can be manufactured into wheels which exactly duplicate each other, the providing a standard "paving surface" on which the sample "soles" can "walk" will permit similar machines to be set up and used anywhere in the country, with the certainty that similar results to those obtained one place will be had elsewhere. In other words, that leather in Chicago which loses 10 grams from 70, in 22 hours' test of 40,000 "steps" will do the same thing on a similar machine in Miami or Quebec. This does not mean that a pair of soles will wear out with 40,000 steps, but that on the machine, a life test of the sole leather can be completed in 22 hours—an achievement in accelerated testing.

In order to provide a reasonable accuracy for the tests, it is essential that the leather be normally dry, as damp tanned skin wears much more quickly than the dry.

The machine is the invention of Mr. P. L. Wormeley, Associate Physicist of the Bureau of Standards, under whose supervision the present model was constructed, and in whose hands the successful tests described have been made.

Wartime Wireless Apparatus for Use on Land and Water

(*Concluded from page 493*)

variable condenser, a crystal detector, a buzzer test, two fixed condensers, and telephone receivers. The detector is said to be by far the most sensitive crystal type yet discovered. It is most rugged in design, and may be instantly adjusted; and once adjusted it will remain sensitive indefinitely.

The entire outfit may be installed in a few hours' time; binding posts are provided for the necessary connections, with the exceptions of the key and receiving set which are connected by means of a plug-and-socket arrangement. The transmitter may be adjusted for standard wave lengths from 150 to 400 meters, which makes it especially suitable for use on cruisers from 35 to 100 feet in length, with their necessarily limited aerials.

Turning to the field of military operations, Mr. Cole has designed a portable set for the use of artillery observers and patrols. The entire set, weighing 20 pounds 2 ounces, is contained in a fiber case measuring 12 by 10 by 10 inches, the lower half containing the complete transmitting set, while the upper half contains the complete receiving set. The two parts of the case may be separated in order to obtain proper conditions for sending and receiving in actual service. The fiber case is of rugged construction, properly riveted, protected by waterproof compound inside and out, and provided with a shoulder-carrying strap.

Actual test has determined that under average day-time sending conditions and with a portable aerial 40 feet high and 100 feet long, having five wires, the portable set will transmit a distance of 15 miles. Under ideal sending conditions

approximately 25 miles can be covered over fairly level land. The receiver, on the other hand, is capable of operating up to and over 500 miles.

The portable set follows the general lines of the switchboard apparatus, except that it is intended for operation on a six- or eight-volt battery. The transmitter wave lengths range from 150 to 400 meters. Exceptionally sharp tuning is possible with the receiving set, which is obviously an important feature in field operations, and the wave lengths obtainable from 200 to 600 meters.

Coal Tar Dyestuffs in Great Britain

ONE of the subsidiary problems of war which ranks high in importance is that of the replacement of German dyes. Not only in the neutral nations has this pinch been felt, but equally among the Allies, who, like us, used to rely upon Germany in this field. Although it has not been possible to turn out all of the thousand and one individual dyestuffs made by the German firms, it is gratifying to know that British chemists and chemical engineers have succeeded in making adequate progress during the year. Of intermediate products, there is a much larger supply. The manufacture of aniline has been taken up by certain colliery proprietors who distill their own coal. This forms the base for the most important black. Beta naphthol and paranitraniline are also being turned out, but the supply is not yet anything like equal to the demand. Other intermediate products are being made on a large scale, but only in sufficient quantities to meet the most pressing of the immediate requirements.

Besides the numerous coal-tar dyestuffs which were being turned out a year ago by British firms, several new ones have been introduced since then. The production of indanthrene blue on a large scale, may be regarded as one of the finest achievements. This blue is the most essential of the modern vat dyes so valued by the cotton dyer and calico printer, on account of their extreme fastness, and was discovered in 1900 by Dr. Rene Bohn, a French-Swiss in the employ of the Bädische Company. Gallocyanine, the discovery of the famous French chemist and calico printer, M. Horace Koechlin, and manufactured in Basle, has also recently been put on the market by a British concern, and its appearance will be welcomed both by wool dyers and calico printers.

Another important blue, alizarin saphirol, principally used in the worsted industry, will shortly be put on the British market. This was discovered, in addition to many other valuable fast dyes, by the distinguished Alsatian chemist, Dr. Robert Schmidt, while in the employ of the Bayer Company. The position of England with reference to the alizarin dyes has been rather more favorable than might have been supposed; for some thirty years ago a British company was organized to operate in this particular field in competition with the German combine, which had "kited" the price to two shillings sixpence per pound. This company has flourished from its inception, paying good dividends, turning out alizarin and allied products of quality equal to, or even better than, the goods made by the German firms, and incidentally fulfilling the purpose for which it was formed, by bringing the price down to a pre-war figure of seven pence. Another fortunate circumstance for the British textile industries is that the Swiss supplies continue to be available; for there are many dyes being used for the home production of which the necessary machinery has not been installed.

Toluol and phenol are the most important materials for the production of high explosives, but they are likewise indispensable raw products in the manufacture of a large number of dyestuffs. It goes without saying which industry shall have priority, and thus there have been restrictions in their use, though manufacturers of uniforms have not been without adequate supplies at all times during the war period. It is interesting to record

(Concluded on page 512)

Accessories That Make the Fighting Aeroplane More Efficient

(Concluded from page 505)

hour after their return a complete set of pictures, each with needle-point detail, is given into the hands of experts assigned to this class of work. These experts, working in conjunction with the general staff, can dissect the pictures and thereby map out plans for the forthcoming military operations. All of which means that the camera is indispensable.

At the numerous aerial bombing schools pilots and observers are taught how to drop bombs accurately on stationary and moving objects on the ground, and on captive balloons. Bombs of all classes are used, from the eight-pound high-explosive bomb to the 200-pound bomb, as well as the phosphorous and rochambite bombs. The latter are at present being employed extensively on the Western front.

The instrument that is used in directing the placing of a bomb on the object aimed at is a simple device, and is provided with several adjustments that can be made almost instantly. One of these gives the speed at which the machine is traveling, another is an ordinary water-level, and both, in conjunction with two mirrors which show the pilot the ground below, serve to aim the bomb. The wind has to be seriously considered when dropping bombs, and most bombs are dropped up wind.

Bomb dropping is a most important branch of the air service, and pilots have been known to drop bombs on enemy trains and transports from fairly good heights, and also on the vital parts of bridges, and on depots and railway junctions. Whole fleets of aeroplanes going over the enemy lines, loaded with high explosive bombs, have done valuable work in destroying munition plants, aerodromes, and submarine bases.

The Importance of Systematic Inspection and Maintenance of Motor Trucks

(Concluded from page 498)

depreciation charges proportionately reduced. Perhaps as good a procedure to follow as any is the one which we lay down herewith.

The first step is to jack up the front axle until the wheels clear the floor. Roll and shake the wheels to determine condition of bearings. Remove the hub-cap and make sure that bearing adjustments are in order. In replacing the hub-caps be sure that they are securely screwed up; and if locking means are provided do not fail to use them. While the front axle is raised affords a good time to inspect the steering system. Test the drag link or steering rod and the tie-bar joints for looseness. Also try the steering knuckles to see if there is any depreciation of the king-bolt.

Next examine the front spring to see that there are no broken leaves and that there is no excessive motion at either the spring supporting bolt or the spring chassis. Go over the front spring clip nuts to make sure that these are tight and that the springs are firmly held to the axle pads. See that all nuts are tight on the steering gear connections and that the cotter-pin locks are in place. Make sure that the steering arm is properly secured to the steering gear shaft. Try the steering wheel for back lash and make suitable adjustment if the play is excessive. Also test for up and down motion in the steering column. If the tires depreciate rapidly it is probably due to lack of alignment of the front wheels, so this point should be checked up. Remove the floor boards and see that all clutch, brake, and control lever connections are tight. Carefully inspect the power plant anchorage bolts to make sure that these are screwed down tightly. Raise the hood over the motor compartment and see that the fan driving belt is at the proper tension and that there are no water leaks around the radiator or any of the water connections, no oil leak around the crank case joints and no gasoline leakage around the carbureter or in the fuel line. Drain out the fuel line strainer to remove any dirt that may be trapped therein.

Next remove the jacks to the rear axle. Roll each wheel to determine condition of bearings, and try to shake the wheels to ascertain whether the bearings are loose. Note also if the brakes are unduly worn or if there is an excessive amount of play between the brake drums and the brake bands. Adjust the brakes, if necessary, but after adjusting make sure that they do not bind when the actuating mechanism is released. Test the spring shackles and the spring clips, as advised for the front axle, and also carefully look over the rear springs for broken spring leaves. Remove the transmission gear case cover and also that of the differential housing to make sure that there is ample quantity of lubricant and that the gearing is not unduly worn. Grasp the propeller shaft firmly and try to oscillate it or move it up and down to determine if there is any wear in the universal joints. See that universal joint flange bolts are tight. Go over all the brake rods to see that there is no wear at the rod ends and that there is no sign of weakness at any point on the rod. Go over all the body fastenings and see that these are tight. Test every nut and bolt in the chassis with a wrench to make sure that these are screwed up firmly.

Start the engine; note whether there is any unusual noise, and see that the power plant is running regularly. Make sure that the clutch engages gradually and releases promptly. See that the gears in the transmission shift easily and without noise. Test out the brakes to see how much effort is needed to apply them and make sure that the brakes are fully applied when the foot pedal or hand lever is not advanced more than three fourths of its effective travel. Any positive engine trouble, such as loss of power, noisy operation or "skipping" will be apparent as soon as it materializes. Irregular engine operation is usually caused by ignition or carburetion troubles, though it sometimes occurs as a result of depreciation in the engine itself. It is not possible to outline the steps to follow in locating ignition or carburetion faults because these depend entirely upon the system of ignition employed or the type of carbureter used, which differs in nearly all trucks. Most experienced truck drivers and any truck repairman can readily locate and remedy the common ignition faults or carbureter troubles that cause misfiring.

The means of adjusting brakes may be easily ascertained by inspection. If brakes do not hold properly and the friction facing is in good condition and free from oil, the failure to grip the drum is probably due to wear in the operating leverage. On some forms of internal brakes, notably those which are expanded by a toggle, wear in the toggle links and pins may prevent proper spreading of the shoes or bands. The only way to counteract this lost motion is to shorten the operating rods, though if there is much depreciation, new parts must be fitted. If the brake lining is charred or worn badly, new friction facings are absolutely necessary. The proper functioning of the steering mechanism and brakes is extremely important as failure of these important members may result in loss of lives and considerable damage to the truck, if not in its complete demolition.

Spring shackles wear out quickly compared to other truck parts even if well lubricated. Spring leaves may break in service, and the clips holding springs to axles must be periodically tightened. The torque members, radius rods, etc., may develop loose joints and cause annoying rattles while the truck is in operation, this noise being intensified by the solid rubber tires and being particularly prominent when the truck is operated under light loads. The tires must not be allowed to wear down too far before renewal. A little false economy in getting the last possible mile out of the rubber may result in a large expenditure for repairs at some future date because of the stresses produced in the mechanism by vibration. Never run a truck with a flat spot worn on the tire so that it "bumps" along or with blocks out of a sectional block tire. A flat spot on a rear wheel will be very injurious to the entire driving mechanism.

Coal Tar Dyestuffs in Great Britain

(Concluded from page 509)

that a firm of manufacturers in Carlisle who do their own dyeing, and had a reputation for fast colors, had the courage to undertake the manufacture of their own indanthrene blue, and have succeeded in carrying to a successful issue what would have been considered by chemical technologists a very hazardous enterprise.

It is only natural that the price of dyestuffs should have risen in all countries, including even Germany, to a point far above their normal level. Certain specialities have recently changed hands at exhorbitant prices, which represent from ten to twenty times their pre-war values. In spite of this, dyers and printers continue not only to exist, but to do a good trade. For the actual dyestuffs cost is only a portion of the cost of dyeing or printing; labor, management, steam, fixed charges, and other matters make up the main cost.

Taking all of these adverse conditions into consideration, it is surprising to find that the cost of dyeing or printing is on an average not more than double that of 1913–14, and about coincides with the enhanced values of certain textiles (*e.g.*, worsteds). It may afford some comfort to certain alarmists that the present prices are on the average considerably lower than those of thirty to forty years ago.

Latterly new difficulties have presented themselves to bleachers, dyers and printers, in that there is a shortage of sulfuric and hydrochloric acids and of bleaching powder. Sulfuric acid is required for the manufacture of explosives both directly and indirectly (*i.e.*, for making the necessary nitric acid), and it is also essential for the manufacture of hydrochloric acid. Nitric acid is produced by distilling Chile saltpetre with sulfuric acid, but in order to obtain the best technical effect it is necessary to employ an amount of sulfuric acid considerably in excess of that demanded by theory. In consequence of this, the residue in the stills, known in the trade as nitric cake and until recently practically a worthless product, contains an equivalent of some thirty per cent of free sulfuric acid. This is now being used for bleaching and worsted dyeing, for which purposes it serves almost as well as the pure acid.

The threatened shortage in bleaching powder, which would affect most branches of the cotton trade, is more serious; but there is no doubt British scientists and technologists will again be equal to the emergency. The alternative will be hypochlorite of soda, produced by the electrolysis of brine. It is understood that electrolysers for this purpose are already being supplied by a Leeds firm, and will shortly be turned out by a well-known establishment in Manchester.

Looking back at the past, and especially considering the feeling which existed, almost bordering on panic, in certain quarters, at the commencement of hostilities, it is really surprising that British industry has done so well. This has taught many lessons; resourcefulness coupled with economy in the textile coloring industries is only one of them.

A Huge Mass of Jade

THE American Museum of Natural History contains the largest piece of jade (nephrite) ever found *in situ* and the largest ever polished, measuring seven feet long by two and a half wide, and weighing 4,718 pounds. In the last number of the American Museum *Journal*, Dr. George F. Kunz tells how he found this piece of jade some years ago in a quarry at Jördansmuhl, Silesia. Its discovery was especially interesting from an ethnological point of view, because certain authorities had maintained that all the jade objects found in Europe were of Asiatic origin. The finding of this great mass of nephrite, sufficient in itself to furnish material for all jade objects and ornaments hitherto found in Europe, proved that it was not necessary to assume that prehistoric jade objects were brought from the Orient in connection with race migrations.

Mack

One of
Twelve

"The most satisfactory trucks we have ever used"

Says Mr. D. J. McCoy, Borough Asphalt Co., Brooklyn, N. Y.

AND Mr. McCoy certainly ought to *know*. For the past year, his company has used a fleet of 12 MACK 5½-ton Model A.C. Trucks.

One of their recent performances was hauling *hot asphalt* for a big paving job on Rockaway Beach Boulevard.

This meant a *thirty-mile trip*—but the MACKS delivered the asphalt *hot and plastic*, thanks to their *speed* and to their specially lined bodies.

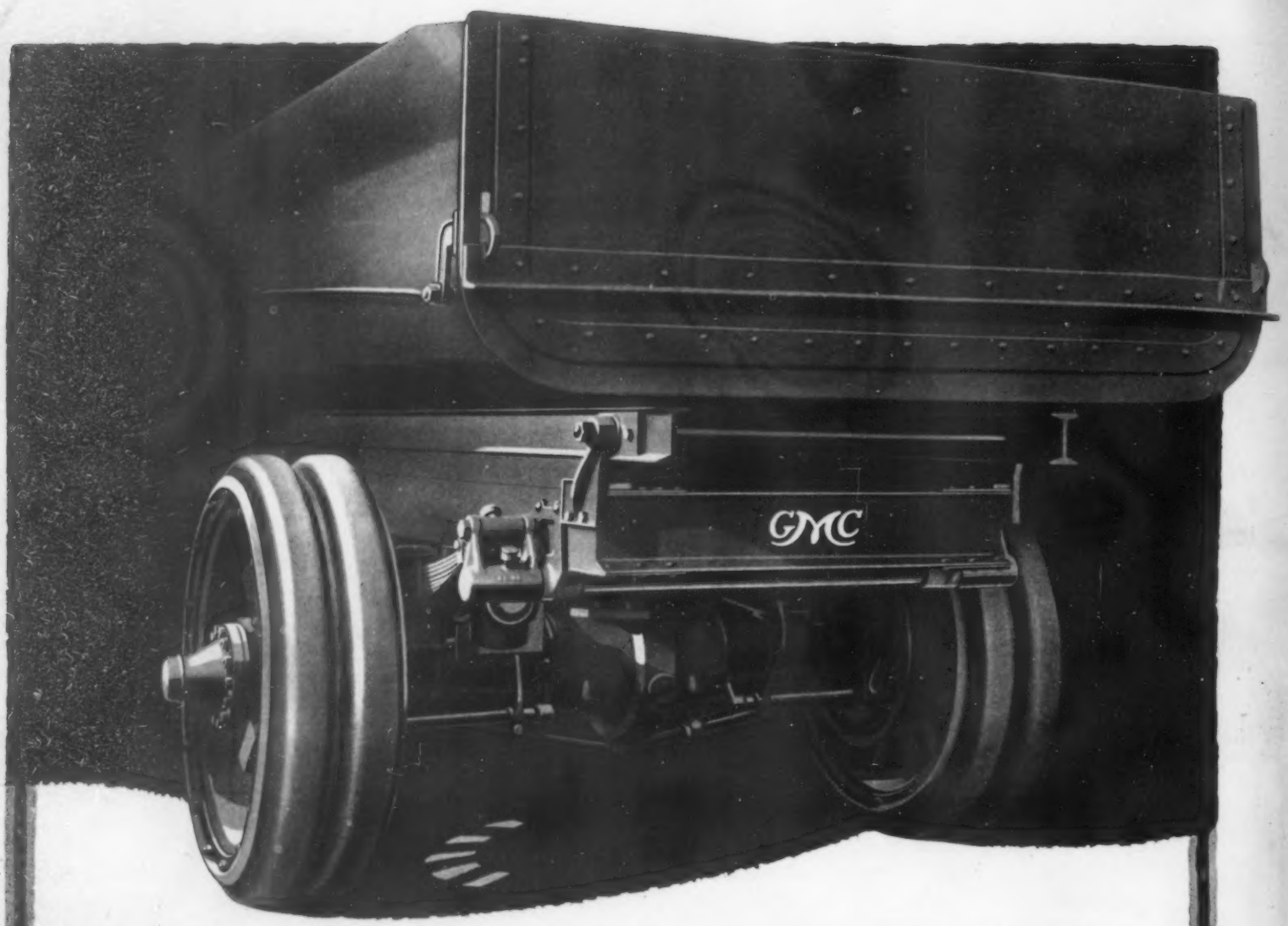
Now, when you consider that asphalt is an especially hard-to-handle "dead" load, Mr. McCoy's further words are significant.

"Nothing can equal MACK Trucks," he said, "especially for dumping."

Performance counts, gentlemen! If you want details on satisfactory Heavy Duty Trucks in 3½, 5½ or 7½ tons capacity, with or without dump bodies, write for **MACK Catalog No. 4.**

International Motor Company
NEW YORK CITY

Performance Counts



DEPENDABILITY

GMC
GENERAL MOTORS COMPANY
TRUCKS

Built in all practical sizes—¾-ton to 5-ton capacity—six sizes in all—each size better suited than all the rest for a certain class of work.

GENERAL MOTORS TRUCK COMPANY

One of the Units of the General Motors Company

PONTIAC, MICHIGAN

New York Boston Philadelphia Chicago St. Louis San Francisco

(191)

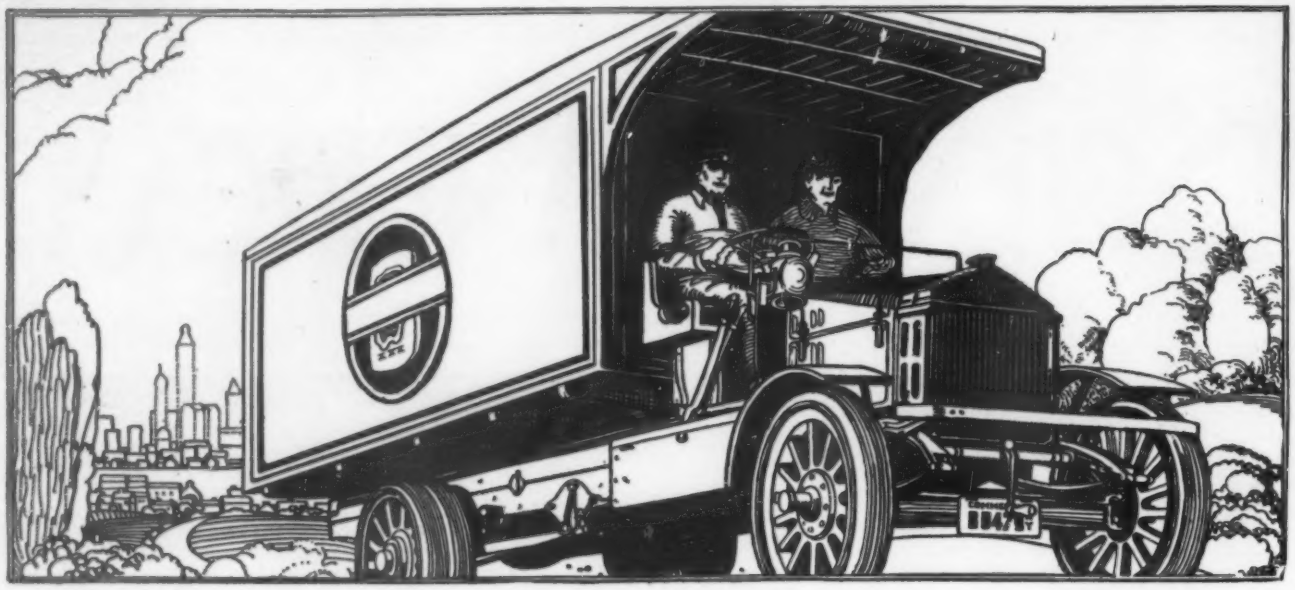
SCIENTIFIC AMERICAN

BOARDING THE ENEMY: A REVIVAL OF OLD-TIME TACTICS IN THE ENGLISH CHANNEL—[See page 525]

May 26, 1917

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents



Builders of Business

NOTEWORTHY among the achievements of Pierce-Arrow Motor Trucks are the many instances where they have developed new and profitable business for their owners.

Time and again Pierce-Arrow trucks by their speed, range and uniform reliability of service have doubled and tripled delivery radius and increased sales in proportion.

PIERCE-ARROW

Motor Trucks

sweeping swiftly and silently through the streets, are a circulating advertisement of prompt and dependable service.

Under all conditions of weather and traffic the Pierce-Arrow Motor Truck can be depended upon for its scheduled mileage on schedule.

In many different lines of business Pierce-Arrow trucks that have written their entire cost off the books of owners are still in efficient and economical operation. So far as we know, every Pierce-Arrow truck sold is still operating satisfactorily—including trucks that have seen six years and 100,000 miles of service.

The Worm-Gear

All Pierce-Arrow trucks are equipped with the worm-gear drive, which is a positive guarantee of effective service under the most difficult conditions.

Specific data is available covering the cost of operation of Pierce-Arrow Motor Trucks in many different lines of business, such as Transport, Grocery, Contracting, Coal, Brewery, Textile, Oil, Dry Goods, Chemicals, etc.

The PIERCE-ARROW MOTOR CAR COMPANY

Buffalo, N. Y.